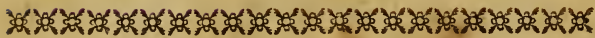


John  
Cranford,  
M.D.









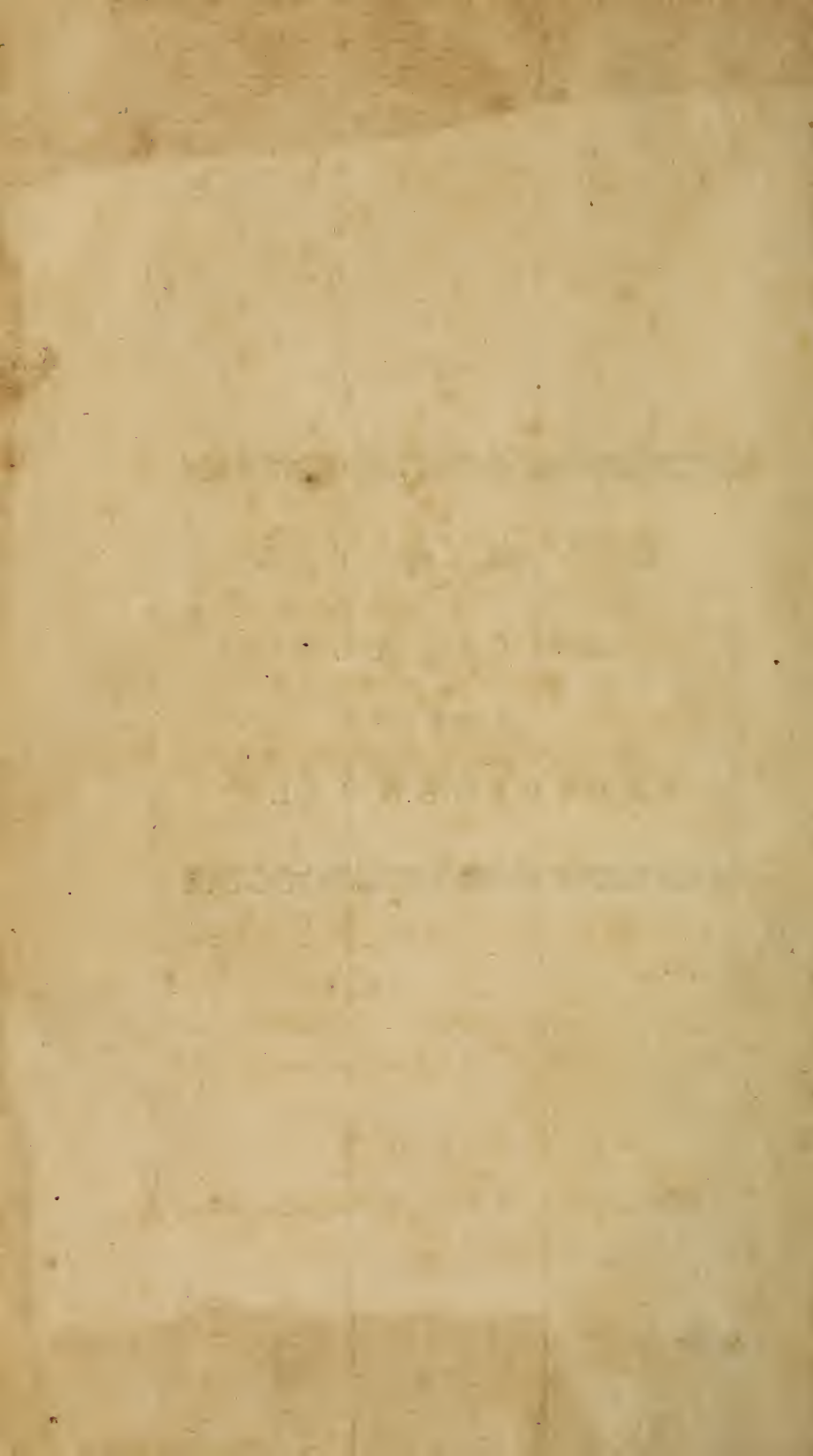
E S S A Y S

M E D I C A L

A N D

E X P E R I M E N T A L.





E S S A Y S

M E D I C A L

A N D

E X P E R I M E N T A L.

THE SECOND EDITION,

REVISED, AND CONSIDERABLY ENLARGED.

TO WHICH IS ADDED AN

A P P E N D I X.

B Y

THOMAS PERCIVAL, M.D.F.R.S.

——— *Relinquamus aliquid quo nos vixisse testemur.*

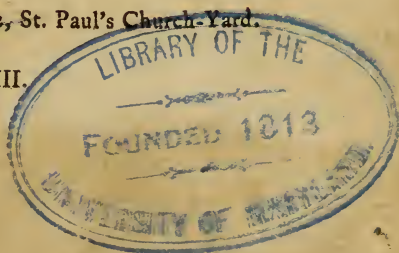
Plin. Epist. Lib. 3. Ep. 7.

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MDCCLXXII.

16243



*Quantacunque fuerint aliorum conamina,  
semper existimavi mihi vitalis auræ usum  
frustra datum fore, nisi et ipse, in hoc  
studio versatus, symbolum aliquod, ut-  
cunque exiguum, in commune medicinæ  
ærarium contribuerem.*

SYDENHAM.

*Crawford*

T O

*Thomas Butterworth Bayley, Esq;*

Of H O P E,

Near M A N C H E S T E R.

**A**CCEPT, dear Sir,  
this tribute of esteem,  
respect, and affection; and  
whilst I am discharging the  
debt of justice to superiour  
abilities, active virtue, and  
the most amiable manners,  
allow me the honour of being  
known

DEDICATION.

known to the world as the  
friend of Mr. BAYLEY, and  
of subscribing myself,

DEAR SIR,

Your faithful, affectionate,

and most obedient Servant,

MANCHESTER, **THOMAS PERCIVAL.**  
1st Decem. 1771.



T H E  
P R E F A C E.

**T**HE Author of the following Essays, presuming on the candid reception which they met with from the public, commits to the same indulgence, the present enlarged and improved edition of them. The first and second Dissertations, which are the productions of his youth, illustrate both the insufficiency of theory, and the danger of trusting  
ing



ing to experience alone in the practice of physic. The annals of medicine abound with instances of the fatal effects of Empiricism, and Hypothetical reasoning, founded on fictitious principles. But these examples, painful as they are to a feeling mind, impeach not the honour or usefulness of the healing art ; and are chargeable only on the ignorance of a few of its professors, and on the credulity of mankind. The History of the Christian Church presents us with a picture still more shocking to humanity : But who disputes the influence of religion, to promote the peace, order, and happiness of society, because superstition hath occasioned so much confusion, misery,

fery, and devaftation? It is ferioufly to be lamented that jufter ideas are not formed of the nature, extent, and objects of medicine in general; and of the feveral branches, into which as a practical fcience, too comprehensive for any individual to exercife, it is now divided. This would prevent the encouragement of illiterate pretenders; would conciliate harmony, and excite a generous emulation amongft the different orders of the faculty; and by confining the exertions of each, within the fphere adapted to their genius and education, would powerfully promote the improvement of Phyfic, Surgery, and Pharmacy. No profeflion requires a more enlarged and cultivated

cultivated understanding, or comprehends a wider circle of knowledge than that of physic. And to the honour of the Physicians of this age and country it may with truth be asserted, that they are peculiarly distinguished as men of liberal education, and extensive learning. (*a*)

THE third Essay consists of experiments and observations on Bitters and Astringents in general, and on the Peruvian Bark in particular. The utility of this method  
of

(*a*) MR. JUSTICE BLACKSTONE recommends the study of the law, to gentlemen of the faculty of physic, with this honourable distinction, “to compleat the character of general and extensive knowledge; a character which their profession, beyond others, has remarkably deserved.”

Blackstone's Comment. Vol. 1. p. 14.

of inquiry is universally acknowledged; and nothing can tend more to the advancement of real science, than the steady pursuit of it. The improvements which have been made in the art of medicine for this century past, are more than equal to those of a thousand preceding years. And these improvements may be justly ascribed to that taste for experiment which hath of late so generally prevailed. But though much hath been done in this way of investigation, there are still numberless untrodden paths in Physic which remain to be explored. And every person of tolerable abilities, who hath patience, assiduity, and a sufficient minuteness of attention, may almost assure himself



himself that his labours will be rewarded with success, and that he can hardly fail of adding some new and useful discoveries to the common stock of medical knowledge.

*Multum egerunt qui ante nos fuerunt, sed non peregerunt; multum adhuc restat operæ, multumq; restabit, neque ulli nato post mille secula præcidetur occasio aliquid adhuc adjiciendi.* (a)

The Author might have confirmed many of the observations contained in this Essay by a variety of experiments, which he has lately made on the Columbo Root; a medicine, which from its efficacy, deserves to be more generally known in practice. But his papers on that subject are laid before

(a) Seneca.

fore the Royal Society, and will probably be published in the next Volume of Philosophical Transactions. (*a*)

THE title of the fourth Essay fully explains the purport of it. An attempt to ascertain the use and operation of a remedy so well known as Blisters, may at first view appear to be unnecessary. But a more attentive examination will convince us of our mistake.

The

(*a*) THE Columbo Root is cordial, corroborant, antiseptic, and powerfully antiemetic. It is a useful remedy in the cholera morbus; in diarrhœas; in the dysentery; in bilious fevers; in a languid state of the stomach, attended with want of appetite, nausea, and indigestion; and in habitual vomitings, when they proceed from a weakness or irritability of the stomach, from an irregular gout, from acidities, or from acrimonious bile. Experience confirms the truth of these observations, and the following facts serve in some measure to explain them.

An

The triteness of the subject is the reason that it has been so much overlooked and neglected; and though vesicatories are employed and recommended by almost every medical practitioner, yet few have attended to their real action, or to the general principles which ought to direct their application.

THE subject of the fifth Essay, the author confesses, is rather curious than useful, of more importance to the inquisitive physiologist,

An infusion of the Columbo Root mixes uniformly with putrid bile, and instantly corrects the fœtor of it; preserves fresh bile from putrefaction considerably longer than most other antiseptics; moderates without suspending the fermentation of alimentary mixtures; prevents them from growing sour; and neutralises acidities when formed, much more completely than Peruvian bark or chamomile flowers.—The virtues of this Root are extracted both by water and rectified spirit of wine, and by cold maceration, as well as by decoction, or infusion with heat.



logist, than to the practical physician. But as all researches into the operations of nature merit our notice and regard, an inquiry into the resemblance between the Chyle and Milk hath certainly some claim to our attention. And if it appear probable, as he presumes it will, that Milk is the Chyle unassimilated, or at least very little changed, it may lead to some useful inferences concerning the proper diet for nurses.

THE two first tracts contained in the Appendix were published separately a few years ago; and as no copies of the former impression now remain, they are reprinted and annexed, not improperly it is hoped, to this Volume of Essays.

THE

THE Observations on the efficacy of external applications in the Ulcerous Sore Throat were written in the summer of 1770, a period when that disease was epidemical in the town and neighbourhood of Manchester. The measles also prevailed very generally at the same time; but though these disorders have been often observed to associate themselves together, and may seem to bear some analogy to each other, from the efflorescence on the skin, and inflammation of the eyes, with which they are both accompanied, no instance then occurred to the Author of their union.

ESSAY

E S S A Y I.

T H E

E M P I R I C ;

O R,

ARGUMENTS AGAINST THE USE

O F

THEORY AND REASONING

I N P H Y S I C .

*Sufficit si quid fiat intelligamus, etiamsi  
quomodo quidque fiat ignoremus.*

CICERO.

*Non fingendum aut excogitandum, sed  
inveniendum quid natura faciat aut  
ferat.*

BACON.



E S S A Y I.

T H E

E M P I R I C;

O R,

MAN OF EXPERIENCE. (*a*)

**I**N this polished age, when every art is advancing towards perfection, and every science enlarging its boundaries, it is a melancholy consideration that MEDICINE should alone be left behind

B 2

in

(*a*) THIS and the following dissertation contain a discussion of the arguments for and against the use of theory and reasoning in medicine. They are not intended as an explanation of the tenets of those two ancient and celebrated sects of physicians, the Empirics and Rationalists, of which Celsus hath given us so elegant  
an



in the general career of improvement. The mists of ignorance and error are now vanishing before the lights of genuine philosophy ; and knowledge, practical and speculative, extends its influence even to the meanest mechanic. But the Hippocratic art, amidst this rapid and almost universal revolution, is at least stationary, if it move not in a retrograde course. And what is singular in its fate, the same causes which have promoted the advancement of the sister sciences, have by a wrong direction checked the growth, and

an account ; but to point out opinions which now prevail in the world, and which naturally arise from the different lights, in which the same subject is viewed by different minds. The author hath endeavoured to suppose himself first of the one party, and then of the other ; in order more fully to enter into the sentiments of each, and by that means do justice to both sides of the question. In this kind of writing it is not easy to avoid declamation ; and he hopes to be excused, if he has indulged some degree of that enthusiasm, with which two antagonists may be supposed to be actuated, when pleading against each other, in support of a favourite cause.

and retarded the progress of one which is

—— fairly worth the seven.

POPE.

THE industry of its professors, by an injudicious application, hath served only to darken and perplex it. Instead of patiently treading in the sure steps of EXPERIENCE, they have followed the false clue of THEORY; and whilst with infinite pains and labour they endeavour to penetrate into the recesses of physic, they have lost themselves in the labyrinths of error. Unhappily for the healing art, their mistakes have coincided with the common propensities of mankind, who are more inclined to search after hidden and undiscoverable causes, than to attend to the obvious phenomena of nature. Blinded with their own fictions, these wanton theorists conceal their ignorance from them-



felves and the world, by unmeaning terms and pompous phrases.

*“ Omnia enim stolidi magis admirantur  
amantque*

*“ Inversis quæ sub verbis latitantia cernunt.”*

LUCRETIVS.

BUT descending from the flights of declamation, let us point out the folly, detect the fallacy, and trace the dangerous consequences of theory and reasoning in medicine.

WHOEVER searches into the annals of physic cannot fail of being astonished at the almost infinite variety of systems and hypotheses, which at different times have been obtruded on the world. The amazing fertility of the imagination is there displayed in its full extent; and perhaps so ample an exhibition of the powers of human invention might gratify the vanity of man, if the agreeable effect  
were

were not more than counter-balanced by the humbling view of so much absurdity, contradiction, and falshood. The idlest opinions have had their abettors; the most groundless fictions have been swallowed with credulity. A list of all the follies which at different periods have been established as articles of faith in medicine, would form the severest satyr on the healing art. Who can withhold his laughter when he reads of expelling, attracting, and concocting faculties; of energies, sympathies, antipathies, idiosyncrasies, and occult causes; of the body being nothing but salt, sulphur, and mercury; of man being a microcosm, and uniting in his frame the motion of the stars, the nature of the earth, of water, air, all vegetables and minerals, the constellations, and the four winds. Yet ridiculous as these several tenets may appear, they have given rise to sects, have been espoused with warmth, and defended with acrimony. But the

excentric genius of the theorists hath not been confined within the limits of physiology, and the laws of the animal œconomy: the hidden causes of diseases, the elements or first principles of medicines, and their secret mode of action on the body, have afforded another no less extensive field for the exercise of their creative imaginations. The bare recital of their fictions, would sufficiently demonstrate their absurdity. But to enumerate them would be an almost endless task. Erasistratus defines disease to be a translation of blood from the veins to the arteries; whereas Galen asserts that as health consists in the equilibrium between dryness and moisture, heat and cold; sickness must depend upon the subversion of that equilibrium. One sect adopts *pletthora* as the cause of all diseases; another denies the possibility of its existence in the body. Sylvius exults in the discovery that an acid is the sole morbid principle; his antagonists ascribe that honour

honour to their alkali. Salt, sulphur, acrimonies, caustics, volatiles, ferments, &c. &c. have each at different times and by different systematics been received as the undoubted *principia morborum*. No less absurd are the fictions of the theorists concerning the elements and qualities of medicines, and their operation on the body. The same drug is represented as hot in one degree and cold in another, or as dry in one proportion and moist in another. Certain remedies are whimsically assigned to particular parts of the body, on which they are supposed to exert their effects by a peculiar predilection. Hence the classes of pectorals, stomachics, hepatics, cephalics, cordials, &c. One medicine attracts and eliminates the bile, another the *pituïta*, and a third the *atra bilis* or melancholy. Some preparations *irradiate* the animal spirits, others *darken* and *obscure* them. But enough of these idle conceits, the off-  
spring

spring of theory, and the disgrace of physic.

PERHAPS it may be objected, that though many vain and groundless hypotheses have been advanced, there are two which will bear the test of ridicule, and which have had the suffrages of the wisest and most learned men in their favour. Let us briefly examine their pretensions to credibility.

I. GEORGE ERNEST STAHL, a German physician, of a subtil and metaphysical genius, supposes two opposite principles or propensities in the human frame; one constantly and uniformly tending to corruption and decay, the other to life and health. The former is founded on the elementary composition of the body, the latter depends on the power and energy of the mind. By means of the nerves, the influence of the mind is extended to every part of the system, and  
if

*A. Bartsch.*



if their action be impeded, disease is the unavoidable consequence. A superabundance and spissitude of the blood is therefore the proximate cause of sickness, as the energy of the mind is thereby diminished, and its action on the body obstructed. Hence to lessen the quantity, and break down the lentor of the blood, the soul exerts all its powers and excites hemorrhages, sweats, diarrhæas, fevers, and the like. Dr. Potterfield and Dr. Nichols have carried this theory still further. The latter in his prælection *de anima medica*, affirms without reserve, that the soul at first forms the body and afterwards governs it, that she regulates and conducts all its vital and natural motions, circulates the fluids and distributes them to the different parts of the system, with such velocity and in such proportion as she judges right, and that whenever the body is disordered, she excites those conflicts and commotions which are best adapted

adapted to restore it to health and soundness.

SUCH are the principles of the Stahlians. —Let the unprejudiced judge whether they need a serious refutation. Could a mariner plan and construct a ship, launch it into the wide ocean, govern it in storms, direct it from shoals and rocks, and steer it safe into the destined harbour, without being conscious of the skill he exerts, and the labour he employs? The analogy is obvious; and it would be equally absurd to suppose that the mind could form the body, regulate all its motions, superintend its health, rescue it from disease, and be perpetually occupied in planning and executing the wisest designs, without the least knowledge or consciousness of the power and energy she every moment exerts.

BUT the first proposition of the Stahlians confutes itself. For if the body  
and



and mind with equal force be constantly and uniformly tending different ways, no change can possibly ensue; agreeable to the well known axiom in physics, that action and reaction are equal, and destroy each other's effect. Not to insist however on this error in philosophy, the doctrine of the Stahlians in confining all diseases to *lensor* and *plethora* is false and absurd. The dropsy, scurvy, *cacochymia*, *ptihisis pulmonalis*, putrid fevers, and many of the nervous class of ailments, are accompanied for the most part with a thin and colliquated state of the fluids. Nor is there more truth in the assertion, that every distemper is an effort of the mind to relieve the body. The slightest laceration of a tendon has been succeeded by the locked jaw, convulsions, and death. An indolent glandular tumour terminates not unfrequently in a cancer. A neglect to evacuate the bladder in due time hath occasioned a suppression of urine; and the palsy has  
been

been the consequence of a profuse hemorrhage. Are these then the wise conflicts of the soul to rescue her suffering partner from impending evil ! and must we view in the same light the *angina maligna*, the *tussis convulsiva*, the spasmodic cholera, the *tetanus*, *cataplexis*, worms, rickets, &c. &c. No one but a theorist, blinded with the mists of his own brain, would answer in the affirmative.

2. THE important discovery of the circulation of the blood in the beginning of the last century by the ever memorable Dr. Harvey, gave rise to the introduction of MECHANICS into medicine. And as that system of philosophy was founded on the general laws of nature, it was obvious to infer its application to the human body ; which was supposed to differ only from the universe of things, in the wonderful variety and complication of its machinery. Bellini, Borelli, Pitcairn,  
Keil

Keil and Boerhaave are the great supporters of this theory. According to the description of the latter, the body is chiefly composed of a conic, elastic, inflected canal, divided into similar lesser ones proceeding from the same trunk, which being at last collected into a reti-form contexture, mutually open into each other, and send off two orders of vessels, lymphatics and veins, the one terminating in different cavities of the body, the other in the heart. These tubes are destined for the conveyance of the animal fluids; in the circulation of which life consists, and on whose free and undisturbed motion health depends. *Obstruction* therefore is the proximate cause of most diseases. And as it is produced either by a constriction of the vessels, or by a *lentor* in the blood, these are considered as the remote causes.

HOWEVER plausible this theory may appear to be at first sight, it will be found  
on

on a stricter examination to be fallacious and defective. The mathematician who calculates the projectile force of the heart, the velocity of the blood in the arteries and the various secretions of the glands, from the known laws of fluids in motion, and the nature of tubes of different shapes and sizes, must unavoidably be exposed to a thousand mistakes. The vessels of the body are too numerous and minute to admit of an accurate mensuration; and they are perhaps every moment undergoing changes from the diversified action of that vital power which animates our wonderful system. Hence arises the contrariety in the computations of philosophers on this subject. Borelli reckons the resistance which the heart overcomes in propelling the blood through the arteries and veins to be equal to 180000 pounds weight: Dr. Hales makes it amount to no more than 51 pounds; and Keil, though he computes the fluids of the human body to be five times more in  
quantity



quantity than Borelli supposes, hath reduced the sum to a single pound. One asserts that the pressure of air, overcome in ordinary respiration, is equivalent to the weight of 14000 pounds; a second proves it to be equal only to a 100 pounds; and a third makes it so inconsiderable, as to be almost below comparison; whilst all the three appeal to mathematical demonstration. A similar diversity appears in the conclusions of the mathematicians, concerning the quantity of bile separated by the liver. To determine this point, Borelli first measures the diameter of the *ductus communis choledochus*, which he finds to be the 225th part of the diameter of the *vena cava*, just before it enters the right auricle of the heart. Hence he infers that if 7680 pounds of blood (supposing the whole mass to be twenty pounds, and to circulate sixteen times every hour) passes through the *vena cava* in twenty four hours, the 225th part of this quantity, i. e.

B thirty



thirty four pounds of bile must in the same space of time be transmitted through the hepatic ducts : a conclusion altogether repugnant to fact and experience. And it will appear to be much more so, if we admit, with the later mathematicians, that the vessels of the human body contain at a medium thirty pounds of blood ; for then the quantity of bile, according to Borelli's method of reasoning, must amount to eighty five pounds in one day. But in this, as in the former instance, Keil widely differs from Borelli, and with greater probability concludes that two drachms of bile and no more, are hourly separated from the liver. In these calculations no attention is paid to the peculiar nature of the animal fluids. Water and wine, a poisonous and wholesome liquid, are governed by the same hydraulic laws, but their effects when circulating in the body would certainly be very different. We know from experience that the velocity of the pulse is influenced  
by

by the state of the blood. Even the accession of new chyle after each meal, quickens the action of the heart and arteries. The human body therefore is not to be considered as a mere machine; and that theory which is built on this foundation is evidently fallacious. (*a*)

BUT the mechanic hypothesis is also inadequate and defective; for the animal frame is incident to numberless diseases which have no dependence on obstruction. The *morbi fibræ debilis et laxæ* are not even by Boerhaave himself ascribed to this cause. The dropfy, scurvy, putrid fevers, small-pox, measles, and *lues venerea*, are inexplicable on mechanical principles.

The

(*a*) In the Philosophical Transactions there is a table in which the several purgatives and emetics commonly in use are enumerated and adjusted by mathematical rules to all ages, sexes, and constitutions. The doses of the medicines are as the squares of the constitutions. And in the Edinburgh Medical Essays there is a formal attempt to correct the errors of this table.

The *hydrophobia* seems to be entirely a nervous affection, and cannot with the least propriety be supposed to arise from obstruction. No inflammation is observable on dissection in the fauces or gullet; nor is there any palsy in the muscles subservient to deglutition. A numerous class of diseases depend upon that sympathetic connexion which subsists between different parts of the body. When the stomach is out of order, languor, debility, watchfulness, the night mare, and sometimes a *cephalæa*, *vertigo*, or *hemisphæria* are the consequences. A rough bone stimulating the nerves of the great toe, hath produced epileptic fits. And it is well known that children from the irritation of the gums in dentition are liable to vomiting, purging, fever, and convulsions. These few instances are sufficient to shew that the body is unhappily subject to many disorders, besides those which proceed from obstruction. And perhaps the conclusion may be carried  
still

still further, when we consider that in the operation for the aneurism a large artery is tied up, and the circulation of the blood for some time almost totally suppressed in the part, without any material injury to health. Morgagni relates that Valsalva affixed two ligatures to the carotids of a dog, who lived above twenty days after the operation, and might have continued longer if he had not been killed for the purpose of dissection. Is it then to be supposed that the obstruction of a few capillaries, which are united together by an infinite number of anastomosing branches, can be productive of such fatal consequences, whilst the course of the blood is stopped in large vessels with impunity? Equally false and absurd is the mechanical hypothesis concerning the operation of medicines, which is supposed to depend upon the size, figure, and gravity of their constituent particles. Thus chalybeates, for example, are recommended in ob-



structions of the *catamenia*, on account of the *momentum* which they communicate to the blood. And on the same principles, mercury is said to break down the texture, and produce a colliquation of the animal fluids. But both these explanations however elegant in theory, are false in fact. From the experiments of the late Dr. Wright (*a*) it is evident that steel never enters the lacteals, and that it exerts its effects solely on the stomach and bowels. And it is surely beyond the bounds of credibility to suppose, that a grain or two of corrosive sublimate, which is light enough to be suspended and dissolved in brandy, is capable, by its extraordinary weight, of dissolving the *crassamentum* of the blood. But it is the genius of theory to dignify trifles, and to ascribe the most wonderful effects to the most insignificant causes.

HAPPY however had it been for the  
world,

(*a*) Phil. Transf. Vol. 50. pt. 2. p. 595.



world, if the medical systems which have been obtruded on it were only chargeable with inutility, absurdity, or falsehood. But alas ! they have misled the understanding, perverted the judgment, and given rise to the most dangerous and fatal errors in practice. A short view of the history of physick will convince us of this melancholy truth. The divine Hippocrates knew how to distinguish between theory and experience ; and he suffered not his doctrines of fire and water, his elements with their powers, nature with its inclinations, aversions, attractions, repulsions, and ratiocinations, to influence his treatment of diseases. But the conduct of his successors was widely different.

ERASISTRATUS reasoning on false and precarious principles, and neglecting experience, the sole test of utility, proscribes the use of venæsection and purging, and condemns them as remedies equally infamous and dangerous.

ASCLEPIADES, from whom the modern sect of mechanics have borrowed many of their doctrines, supposing that health depends on the just proportion between the pores of the body and certain corpuscles they are destined to receive and transmit, and that it is impaired whenever these corpuscles are obstructed in their passage, orders exercise on horseback in the most ardent fevers. He advances it as a maxim, that one fever is to be cured by raising another; and that the strength of the patient is to be exhausted by watching and the endurance of thirst. And his practice was strictly and severely conformable to his principles; for he would not allow the sick to cool their mouths with a drop of water during the two first days of the disorder. But he indulged his phrenitic patients in the use of wine, even to intoxication.

THEMISON, the disciple of Asclepiades,  
rejected

rejected some of the opinions of his master, and founded a new sect called the Methodics. But his practice did not materially differ from that of Asclepiades, and his success is recorded by Juvenal in the following line.

” *Quot Themison ægros autumnno occiderit uno.*

GALEN for the most part followed the plan of Hippocrates in the treatment of diseases. But as the *materia medica* in the course of five hundred years had been much augmented, the prescriptions of Galen were devoid of the Hippocratic simplicity. And it is more than probable that his false and ridiculous theory concerning the primary qualities of hot and cold, dry and moist, led him into dangerous errors in the composition of medicines.

ORIBASIUS, Ætius, Alexander Trallianus, Paulus Ægineta, and their successors  
the

the Arabian physicians, attempted no material innovations, but humbly trod in the footsteps of Galen. The Arabians indeed introduced several new and valuable medicines into practice, such as manna, fenna, tamarinds, cassia, and rhubarb. And by the cultivation of chemistry, they laid a foundation for the greatest and most important revolutions in the art of medicine. I omit the mention of Albertus Magnus, Arnoldus de Villa Nova, Raymond Lully, Johannes de Rupefciffa, Ifaac and John Hollandus, and Basil Valentine, who were all chemists, many of them inventors of *panaceas*, and probably the authors of much mischief. In the beginning of the sixteenth century, Paracelsus a native of Switzerland stood forth, and with matchless arrogance, and the most supercilious contempt of others, proclaimed his opinions to the world. Seated in his Professorial chair at Basil, he solemnly burnt the writings of Galen and Avicenna, intending to become himself, the sole oracle

oracle in physick. But his theory is wild, romantic, absurd, and dangerous; a ridiculous mixture of magic, astrology, and chemistry. The body he says, is composed of salt, sulphur, and mercury; and in these three first substances, as he terms them, health and diseases consist. The mercury, in proportion to its degree of volatility, produces tremors, mortifications in the ligaments, madness, phrensy, and delirium. Fevers, phlegmons, imposthumations, and the jaundice, are the offspring of the sulphureous principle; and the cholick, stone, gravel, gout, and sciatica derive their origin from salt. What fatal errors in the treatment of diseases, must such idle notions of their causes, unavoidably produce? The medicines which Paracelsus and his followers employed, were generally metallic preparations, which in such rash and presumptuous hands, were doubtless, frequently pernicious, and always dangerous. Their common purge in every disorder was *mercurius præci-*



*præcipitatus*, reduced to pills, and made up with the *theriaca* or *mithridate*. About a century after Paracelsus, Van Helmont took the lead in physick; a man of such indefatigable industry, that he spent fifty years in torturing by every chemical experiment the animal, vegetable, and mineral kingdoms. He was a person of learning, and ability, but like his predecessor, had the folly of pretending to a universal remedy. (*a*) By his writings he defended, enlarged, and promoted, the chemical theory; and as Sylvius de la Boe, and Otho Tachenius soon after adopted his system, it became almost universal. All the operations of nature in the world at large, as well as in the animal œconomy, were reduced to the laws of chemistry; and

(*a*) Veteres chemici, quorum interpres est Helmontius dixerunt, in cuprum insitum esse genium metallicum, qui vix mole corporea, sed tantum irradiatione sanat omnes fere morbos; et Helmontius dixit, hoc fieri solo attactu tincturæ cupri ad linguam.

Boerhaave de morb. Nervor. p. 764.

and every phœnomenon was accounted for, on the principles of fermentation, putrefaction, corrosion, effervescence, solution, or mixture. The functions of the body were explained by analogies drawn from chemical experiments. Thus the solution of the aliments in the stomach was ascribed to an acid, because acids were observed to dissolve metals, and other substances of the firmest texture. Muscular motion was accounted for, by an effervescence and explosion in the imaginary rhomboidal receptacles, resembling the tumults raised by the mixture of an acid and an alkali. The generation of animal heat, was imputed to the combination of the acid chyle with a supposed balsam of the blood, because a similar effect is produced by uniting acids with distilled oils. If the acid of the chyle happen to be highly concentrated, and the juices very acrimonious, according to this theory, an ardent fever is excited. The cold fit of an intermittent, was ascribed to the action of  
nitre

nitre, sea salt, or sal ammoniac in the blood, because these substances were found to refrigerate water in a remarkable degree.

FROM this absurd and groundless theory, the practice of the chemical sect was deduced ; of which I shall give one memorable and fatal instance. In the year 1669 an epidemic fever raged at Leyden, and carried off more than two thirds of the principal inhabitants of that city. The symptoms which accompanied it were a disordered stomach, vomitings, anxiety, quotidian or tertian paroxysms, spots, oozing of blood from different parts of the body, dysenteric stools, foetid urine, great debility, apthæ, and other appearances which indicated a very high degree of putrefaction. But Sylvius de la Boe, who was at that time a Professor in the University of Leyden, ascribed the distemper to a prevailing acid, and attempted the cure of it by absorbents and other medicines

medicines of a septic nature ; to which injudicious practice we may justly impute a considerable share of that uncommon fatality which attended the progress of this fever. And is it not more than probable, that the present practice of giving the *testacea* in acute distempers hath a dangerous and pernicious tendency ? If acridities prevail in the *primæ viæ* they will indeed correct them ; but with this inconvenience, that they generally occasion costiveness. And if they remain unneutralised in the first passages, they will powerfully promote putrefaction, and by concreting with the mucus of the stomach and bowels, prove highly oppressive and injurious.

I HAD almost omitted to mention a theory of the most dangerous tendency, which the chemists adopted from Galen, and enriched with many absurd additions of their own invention. They supposed the body to be endued with certain *animal*



*mal spirits*, as they were called, generated in a manner similar to that of obtaining brandy from wine by distillation. These spirits were considered as the seat of various diseases, particularly of inflammation; and were thought capable of being infected with *something* of a peculiarly deleterious nature. Hence it became a *desideratum* to expel this unknown enemy out of the system; and as it was observed that acute distempers are sometimes terminated by a critical sweat, it was concluded that the most powerful sudorifics were the best means of accomplishing this desirable end. This gave rise to the destructive and fatal practice, which soon became universal, of administering heating remedies in diseases of an inflammatory nature; a practice productive of great devastation amongst the inhabitants of Europe. Sydenham, the English Hippocrates, was the first physician who had understanding and courage enough, to stem the rapid and overwhelming torrent:



rent; and we are now at last taught by sad experience, founded on the destruction of numbers of our fellow creatures, that the cooling regimen is alone to be employed in such distempers. The small-pox affords us a remarkable example of the opposite effects of the two different methods of treatment. And the amazing success which hath attended the new mode of inoculation, is a proof, undeniably convincing, of the excellence and safety of the one, and of the danger and frequent fatality of the other. So powerful is the action of heating remedies in this disorder, that a single glass of mountain wine, given even after the eruption is completed, is said to have produced an additional number of pustules.

THE system of Stahl, which succeeded that of the chemists, though false and absurd, is not chargeable with any pernicious tendency. As it chiefly relates to the influence of the mind over the body,

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the doctrine of diseases which it inculcates is simple, and the indications of cure which it furnishes, are few and at least harmless. Thus when the soul in her efforts to relieve the body runs into excess, and excites an immoderate hæmorrhage, *diarrhæa*, or fever, she is to be checked and restrained. On the contrary when she acts negligently or too feebly, she is to be roused and stimulated to an exertion of her powers. In these instances the conclusions of the Stahlians, though deduced from groundless principles, are certainly just, and their practice is supported by experience, the true standard of fitness and propriety in physick.

THE Mechanic Theory, though better supported than the Stahlian, hath a more dangerous influence on the treatment of diseases. Thus, for example, in the management of the small-pox, a physician who is strongly attached to the system of obstruction, and regardless of experience,

perience, might commit the most fatal errors. As the distemper, according to the mechanical hypothesis, consists in a certain matter thrown off from the blood, and locked up in the capillaries of the skin, where being gradually accumulated it forms pustules; he would probably attempt either to disperse it by repeated purging and venæsection, or to promote its passage through the small cutaneous vessels, by the most powerful sudorifics. The first method of cure would occasion a sudden sinking of the pocks; the second would render them putrid, confluent, and malignant. And thus the unfortunate patient would fall a sacrifice to reasoning and theory. I mean not by this illustration, to charge the mechanic sect with having adopted so dangerous a method of treating the disease under consideration. The plan of cure prescribed by Boerhaave is judicious and successful; but it is a deviation from his favourite hypothesis of obstruction, and is founded on experi-

ence and observation. There are however some fatal instances, in which the mechanical systematics have regulated their practice by their theory. How many unhappy wretches fell by the lancet, or sunk under the operation of cathartics, in the ulcerated fore throat, till the sagacious Fothergill pointed out the true nature, and right management of that disease? It is not long since crude mercury was considered as a *panacea*, and taken universally by the healthy as well as the sick, to prevent obstructions in the one, and to break down by its gravity those which were already formed in the other. On the same principle, the spirit and salt of hartshorn were exhibited indiscriminately in almost every ailment; for as they colliquate the blood when taken out of the body, it was not doubted but they would dissolve that lentor of the fluids which was, and is still by many, regarded as the most general cause of diseases.

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IT is evident then that THEORY is absurd and fallacious, always useless, and often in the highest degree pernicious. The annals of medicine afford the most striking proof, that it hath in all ages been the bane and disgrace of the healing art. And as it favours the indolence, flatters the vanity, and gratifies the curiosity of man, ever inquisitive after causes, I fear the passion for it will not be easily suppressed amongst the professors of medicine. The invention of an hypothesis is a work of no difficulty to a lively imagination; and the fiction by its tinsel glitter, never fails to dazzle the ignorant and vulgar. But to watch with close attention the operations of nature, to treasure up a store of useful facts, to learn by accurate observations the diagnostics of diseases, and by unbiassed experience, the true method of cure, requires unwearied labour, assiduity, and patience, at the same time that it admits of no pompous display of wit or knowledge.



The wise, however, value not genuine science less, for her unassuming deportment, and simplicity of attire; and the opinion of the ignorant would be unworthy the consideration of a judicious physician, if humanity did not interest him in the concerns of such numbers of his fellow creatures, who unhappily fall under that denomination.

E S S A Y II.

T H E

D O G M A T I C;

O R,

ARGUMENTS FOR THE USE

O F

THEORY AND REASONING

IN PHYSIC.

*Experientia fallax, judicium difficile.*

HIPPOC.

*Medicina in philosophia non fundata, res  
infirmum est.*

BACON.

E S S A Y II.

T H E

D O G M A T I C;

O R,

R A T I O N A L I S T.

**T**HOUGH reason is the most exalted faculty of man, and the source of that high rank which he holds in the universe of God, there is a set of groveling spirits in the world, who vilify the powers of the understanding, and with inverted pride, glory in sinking themselves to a level with the brute creation. Of this class are the EMPIRICS, who have laboured

laboured with infinite pains, to banish all theory and reasoning from the art of medicine. Experience, they affirm, is the sole guide to safe and successful practice; and fatal is the temerity of such who deviate from the beaten path, and trust in any instance to the direction of their understandings. The proximate cause and hidden nature of diseases are beyond our ken, and it is equally absurd and useless to attempt their investigation. All that is necessary to their cure is plain and obvious, and requires no deep or philosophical researches. We know the ailments to which the human body is incident; we are acquainted also with a variety of active remedies; and *use* alone hath taught us to adapt the one to the other. Thus argue the empirics; with a sagacity adequate to the rank of beings, to which by their contempt of reason they degrade themselves. The subject however is worthy of an attentive examination.

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THERE are two methods of acquiring experience in the art of medicine ; one by reading, the other by practice. The first opens to our view a wide and almost boundless scene of knowledge, presenting us with the lore of all preceding ages : the last is limited and confined, and furnishes a very scanty harvest of instruction. Both are necessary to form the skilful and expert physician ; but without the concurring assistance of our judgment and understanding, neither of them will be found of any other avail, than to perplex us with uncertainty, and to lead us into error.

WHOEVER sits down to study the volumes, ancient and modern, which have been written on the subject of medicine, will be amazed at the multiplicity, and confounded with the contrariety of the facts and observations which he meets with. And if he read with no other view  
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than to inform himself of the experience, and blindly to submit to the direction of his predecessors in the healing art, he will either remain in perpetual doubt and suspense, or will treasure up an indigested mass of contradictory materials, burthensome to his memory, and unfit for use. An undistinguishing credulity is in no science so absurd and dangerous as in physic. Here every fact which is advanced should be examined with accuracy, and admitted with caution. The histories of diseases are frequently the records of falsehood; at least they contain such a mixture of error and truth, as requires the exertion of reason, and an extensive knowledge of the animal œconomy, to separate the one from the other. Still more dubious and uncertain is the therapeutic part of medicine, which hath been subject to all the vicissitudes of fashion, and regulated by the follies, prejudices, and passions of men. How many *panaceas* have been obtruded on the

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the world, whose miraculous effects have ceased the moment they became known? Every author hath his favourite remedy; and what he extols perhaps another may condemn; each pleading in his own behalf the testimony of experience. The annals of physick abound with instances of this kind: thus Hippocrates, Galen, Sydenham, and Boerhaave, with numberless other inferior names, are enlisted on the side of venæsection; whilst Erasistratus, Paracelsus, Van Helmont, and the Cartesian sect, totally banish it from the circle of practice. A similar fate hath attended the other means of evacuation; and purgatives and emetics, at different times, have been strongly recommended, or ignominiously proscribed. Antimony was formerly considered as a poison, and its use was forbidden by a publick edict at Rome; whereas now it is employed under various forms, and constitutes one of the most valuable articles of the *materia*

*teria medica.* The Peruvian Bark soon after its introduction into Europe, met with the most powerful opposition. Numberless mischiefs were ascribed to its operation, and cases recited wherein its effects were said to be obviously pernicious. Even those who thought the most favourably of it, regarded it as a dangerous though efficacious medicine, and never administered it, but with caution and reserve. At present it is given in the largest doses, and in such a variety of disorders, that it is become an almost universal remedy. Opium, Steel, and Mercury, have also undergone their several revolutions, and the most contradictory testimonies may be collected concerning their nature and effects. These few instances (for many more might be adduced) sufficiently prove the absurdity of blindly adopting the experience of *others*; and it will be found on examination that *our own*, without the assistance of theory and reasoning, is



no less exposed to uncertainty and error. The diseases to which the human body is obnoxious are so various, and frequently so complicated with each other, that it requires the clearest judgment to distinguish them with accuracy, and the nicest skill to treat them with propriety. Their symptoms are to be weighed with attention separately as well as collectively; the temperament, age, and sex of the patient are to be considered; and the remote, and occasional causes of sickness to which he may have been exposed, are to be examined into, before any conclusion can be drawn concerning the *genus* of the ailment, or the indications of cure. In the application of remedies, regard is to be had to the nature, internal source and period of the distemper, and to the peculiar habit or idiosyncrasy of the sick person. But this implies the exercise of reason, and besides experience requires a knowledge of the structure and functions of the animal frame, of the changes produced



duced in it by disease, and of the powers and qualities of medicines: all which the empiric rejects as visionary and useless.

“In a watch every one observes when the finger deviates, but the artist alone, who is acquainted with the exquisite structure of the machine, can correct and amend its movements.” A constant and diligent attendance on the sick, may instruct us in the external face of diseases, and enable us with some degree of certainty to prognosticate their issue. But without theory and an exertion of our rational faculties, it will never furnish any other than the mere fortuitous means of relieving them. The savage Indian, by his accurate observation of natural signs, can frequently foretel those tremendous storms to which America, at certain seasons, is exposed: But of what avail would this have been in preventing the impending ruin, if philosophy had not accomplished what was impossible to rude experience? To the ingenious Franklin

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our colonies owe the warmest gratitude, who by investigating the nature and causes of thunder and lightning, hath pointed out the method of warding off their destructive effects. How blind and dangerous would be all attempts to cure the disorders of the eye, without a knowledge of its structure, and an acquaintance with the theory of vision? And yet the empiric is professedly ignorant of both. Suppose him to be consulted by a patient labouring under the *gutta serena*: no external defect appears, no pain is complained of, and the health of the body in every other respect is perhaps unimpaired. By what signs will he be able to determine the seat of the disease; or upon what principles will he proceed in the treatment of it? Confusion, uncertainty, and danger must necessarily attend his random practice. By the laws of the animal œconomy, there subsists a certain sympathy between different parts of the body; by which

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the disordered state of one organ impairs the functions of another. The head and stomach, for instance, have an almost universal consent with the rest of the system, and of consequence are subject to various and sometimes opposite causes of indisposition, each indicating a different and peculiar method of cure. Thus watching, flatulency, indigestion, the gout, rheumatism, or inflammation, may produce the head-ach; and sickness or vomiting may arise from surfeiting, from a load of mucus, from putrid bile, from an affection of the kidneys, and from many other sources. In all these cases the empiric, if he act consistently with his principles, will attend only to the leading symptom, and will indiscriminately apply his stomachic cordial, or cephalic plaister, without any regard to the origin or nature of the malady.

MAY we not therefore justly conclude, that mere experience, whether derived  
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from books, or acquired by personal observation, is insufficient of itself to qualify us for judicious and successful practice. “ I look upon a good Physician,” says the amiable Mr. Boyle, “ not properly as a servant to nature, but as a counsellor and friendly assistant, who in his patients body furthers every thing which he judges to be conducive to the welfare and recovery of it.” To this end a knowledge of the animal œconomy, of the influence of external causes on the human frame, of the state of health, and the changes induced by disease, is absolutely necessary. And this is the foundation on which the Rationalist erects the superstructure of medicine. He explores the writings of the ancients and moderns, he attends diligently to nature in her operations, he selects and arranges facts, and deduces general conclusions, and thus forms a consistent, rational, and useful theory,



on which his practice is built. (a) He neither indulges a warm and creative imagination, nor yet confines himself within the limits of one narrow hypothesis, well knowing the absurdity of either extreme. With the Stahlians he believes that the soul, or nature, as it is now called, frequently exerts herself in the cure of diseases, or in expelling from the body whatever is offensive and hurtful. Thus a *crapula* occasions a *diarrhæa*, and a crumb of bread in the wind-pipe excites a fit of coughing. But he is aware likewise, that the efforts of nature in such cases may be too powerful; that a salutary *diarrhæa* may terminate in a dysentery, and a fit of coughing in universal convulsions. He adopts also, with  
 restric-

(a) ALTHOUGH the arguing from experiments and observations by induction, be no demonstration of general conclusions, yet it is the best way of arguing which the nature of things admits of; and may be looked upon as so much the stronger, by how much the induction is more general.

NEWTON.



restrictions, the mechanical and chemical hypotheses, and admits that obstruction is often a cause of disease, and that many changes in the body are reducible to chemical and mechanical principles, of which he deems inflammation and acrimony to be sufficient proofs. But he is not wedded to systems, nor anxiously bent upon explaining every phœnomenon which occurs in the animal frame. He diligently avails himself indeed of all the assistances with which philosophy furnishes the healing art; but sensible of its imperfection, he ingenuously acknowledges that in diseases there are numberless anomalous symptoms, that the operation of medicines is often irregular and uncertain, and that even in the healthy body there are many appearances, which are inexplicable to the wisest and most experienced of the faculty. But where his theory is deficient, his practice is proportionably more cautious and reserved. If experience fails

him, he calls in analogy to his aid ; (*a*) and judges it better to pursue a doubtful path, than to stand still in uncertainty and suspense. In the most intricate cases, however, he is not totally without a clue : Reason and philosophy are his guides ; and under such direction, there is at least a probability that he will not mistake his course. And by thus treading occasionally in unbeaten tracks, he enlarges the boundaries of science in general, and adds new discoveries to the art of medicine. In a word, the Rationalist has every advantage which the Empiric can boast, from reading, observation, and practice, accompanied with superior knowledge, understanding, and judgment.

(*a*) Ejus (analogiæ) hæc vis est, ut id quod dubium est, ad aliquod simile de quo non quæritur, referat ; ut incerta certis probet.

Quint. Inst. Orat. l. 1. c. 6.

E S S A Y   I I I .

E X P E R I M E N T S

A N D

O B S E R V A T I O N S

O N

A S T R I N G E N T S

A N D

B I T T E R S .

*Nata est ars ab experimento.*

QUINTILIAN.

## ESSAY III.

### EXPERIMENTS AND OBSERVATIONS ON ASTRINGENTS AND BITTERS.

#### EXPERIMENT I.

**A**N ounce of PERUVIAN BARK, coarsely powdered, was divided into two equal parts, one of which was infused forty eight hours, in six ounces of cold spring water; the other was boiled over a slow fire forty minutes, in nine ounces of water, till about a third part of the water was evaporated. The infusion and decoction were each filtered through linen rags doubled, and of equal fineness.

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FOUR grains of *sal martis* were dissolved in an ounce of spring water, and one drachm of this solution was added to equal quantities (viz. half an ounce) of the turbid decoction and infusion. Each assumed a deep purple colour, scarce perceptibly different in degree, though I thought the infusion, after standing a while, acquired rather a more dusky purple than the decoction. The infusion had a deeper tinge, and more of the taste and smell of the bark in substance than the decoction: Its taste indeed exactly resembled the bark, after it has been broken down, and chewed for some time in the mouth.

## EXPERIMENT II.

EQUAL quantities of each *residuum* were boiled over a slow fire in three ounces of spring water, for the space of twenty minutes. The decoctions were equally turbid, exactly similar in taste, and

and on the addition of the chalybeate solution, in the proportion of one drachm to half an ounce, they assumed precisely the same colour, viz. a dusky brown like chocolate, but inclining somewhat to purple.

### EXPERIMENT III.

FIVE drachms of each *residuum* were infused for the space of forty hours, in an ounce and an half of Jamaica Rum, which was sufficiently pure, and unimpregnated with any astringent matter from the cask. The tinctures were exactly alike in taste and colour; and on the addition of one drachm of the chalybeate solution, they were instantly changed from a deep red to a dark and dirty brown, which was precisely the same in both tinctures.

EXPE-

## EXPERIMENT IV.

To half an ounce of powdered bark was added an ounce of cold spring water. The mixture was well triturated in a marble mortar, after which it was suffered to remain at rest till the gross powder subsided. The clear liquor was then carefully poured off, and fresh water to the quantity of half an ounce was added; the trituration was renewed, and afterwards part of the *menstruum* poured off again as before. This method was pursued for the space of thirty four hours, in which time six ounces of water were combined with the bark. The mixture was then infused fourteen hours, without heat, and strained off. This infusion was found to have the smell and taste of the bark, in a considerably greater degree than either the decoction, or the infusion without trituration, [Exper. I.] and it assumed a much blacker colour,

lour, on mixing with it one drachm of the chalybeate solution, than either of the two former preparations.

## EXPERIMENT V.

It was attempted to determine the comparative strength, or rather astringency, of five preparations of the bark, viz. the extract, decoction, cold infusion, tincture, and triturated infusion.

TEN grains of the extract carefully made, and as free from *empyreuma* as this officinal preparation is generally found to be, were mixed with an ounce of hot water. But so imperfect was the solution, or to speak more properly the suspension of the bark, that in a few minutes a large powder was deposited at the bottom of the glass. This however was shaken up, and one drachm of the chalybeate solution was added to the mixture. The same quantity was added

to

to half an ounce of the decoction, infusion, tincture of the London Dispensatory, and triturated infusion. The last assumed by far the deepest black, the extract approached nearest to it, and the tincture appeared to be the least tinged. The decoction and infusion were precisely alike in colour.

#### EXPERIMENT VI.

THE *residuum* of the triturated infusion, [Exper. IV.] was boiled over a slow fire in three ounces of water, for the space of twenty minutes. The decoction when cold was strained off. It was of a paler colour than the decoctions mentioned in Exper. II. although there was a portion of powdered bark suspended in it, which, by the trituration, had been rendered fine enough to pass through the filter. This powder on standing subsided to the bottom of the vessel, and left the decoction



coction much more limpid than it was before.

To equal quantities of this and of the two decoctions mentioned above, one drachm of the chalybeate solution was added. The black tinge was manifestly weakest in this decoction, though the difference was not so great as might have been expected from the diversity in their sensible qualities of taste and smell; owing perhaps to the fine powder of the bark which floated in it, and retained some degree of its original astringency.

### EXPERIMENT VII.

EQUAL quantities of the simple and of the triturated infusion, were boiled for the space of seven minutes over a quick fire. Both lost their transparency when cool; but the latter assumed a much more turbid appearance than the former,

former, exceeding even that of the decoction from fresh bark [Exper. I.] and after standing twenty four hours, it deposited a very copious sediment.

### EXPERIMENT VIII.

HALF an ounce of powdered bark was infused forty eight hours, in five ounces of spring water, and one ounce of white wine vinegar. The mixture was placed near a warm fire, and at certain intervals was smartly shaken. It was then filtered through a linen rag doubled. The taste of the vinegar was in a good measure covered, though the smell was not; but the *menstruum* was not so fully impregnated with the flavour of the bark as the infusion. [Exper. I.] One drachm of the chalybeate solution was added to half an ounce of this acid infusion; at first no change of colour took place, but in a few hours a slight black tinge appeared.

EXPE-

## EXPERIMENT IX.

HALF an ounce of powdered bark was well triturated, in the manner described in exper. IV. with six ounces of warm water; after which the mixture was poured into a bottle, placed near the fire, and frequently shaken. This process lasted forty eight hours. The infusion, when strained off, was found to be more perfectly impregnated with the bark, than the triturated infusion with cold water [Exper. IV.] as appeared by comparing their colour, taste, and smell, and by the deeper black which it instantly assumed on the mixture of one drachm of the solution of *sal martis*.

## EXPERIMENT X.

HALF an ounce of powdered bark, and two drachms of stone quick lime, warm from the kiln, were rubbed together

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until

until they were thoroughly united ; then six ounces of spring water were gradually poured on, the powder and water were well incorporated by triture, and the mixture was set by to infuse for twelve hours. Two ounces of it were then filtered through a double linen cloth : the remainder stood thirty six hours longer, and was often agitated ; after which it was strained off. The smell of the bark was almost entirely covered in both the infusions, which were strongly impregnated with the lime, and had an extremely disagreeable flavour. The first was of a pale colour, and possessed but a slight degree of bitterness ; the latter had a deeper tinge, and was equally bitter and nauseous. Neither of them struck a black colour with the chalybeate solution, which as soon as it was added occasioned the separation of a yellow sediment, which in a few hours subsided to the bottom of the glass. Compared with the triturated infusion

[Exper.



[Exper. IV.] these preparations appeared to be much weaker both in colour and taste. The *residuum* did not sensibly effervesce with oil of vitriol.

### EXPERIMENT XI.

THE decoction and infusion, were found to be impaired in strength after standing six or seven days; although it was the winter season, and the weather was severely cold. The infusion became paler coloured, and at the same time deposited a slimy sediment. The decoction at the end of seven days, assumed an almost milky hue, and struck but a faint black with the chalybeate solution. The simple infusion also had lost much of its astringency; but the two triturated infusions were very little altered in that respect.

### EXPERIMENT XII.

To determine the time requisite for  
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obtaining



obtaining a sufficiently strong impregnation of the Peruvian bark in cold water; four infusions were prepared, by macerating equal quantities (two drachms) of the fine powder of the *cortex*, in four ounces of rain water. (*a*) After two hours infusion, the first was filtered; the second after seven hours; the third after nineteen hours; and the fourth after forty eight hours. The second infusion, which had been prepared by seven hours maceration, appeared by its taste, smell, colour, and by the hue which it assumed on dropping into it a saturated solution of green vitriol, to be considerably more impregnated with the bark than the first, and to be equal in strength to the other two preparations. This experiment demonstrates that the *cortex* yields its virtues,

(*a*) THE foregoing infusions of the bark would have been stronger, had they been made with the fine powder of the *cortex*; and they would have struck a deeper black with green vitriol, had a less quantity of the chalybeate been employed.

tues, in a short time, to cold water, and that it is unnecessary to continue the infusion longer than seven or eight hours.

PHYSICIANS in general agree, that the PERUVIAN BARK is most powerful in its effects when taken in substance. But as the stomach is frequently unable to bear it, and as many patients have an almost invincible aversion to it in that form, it is of importance to determine in what preparations the virtues of this valuable drug are least impaired, and whether it may not be administered under a form that is elegant, palatable, and at the same time sufficiently efficacious. The decoction of the bark hath always appeared to me, to be an injudicious preparation: for though the *cortex* is not a substance of much volatility, (*a*) yet

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there

(*a*) ASTRINGENCY is perhaps not so fixed a quality in vegetables, as is commonly supposed; for I am well informed

there is a certain *aroma* accompanying it, which the heat of boiling water cannot fail to dissipate; (*a*) and consequently the medicine is deprived of one of its component parts, in which probably some share of its virtues resides. The bark likewise undergoes a decomposition by boiling; the resin is separated from the gum, and remains suspended in the watery *menstruum*. This renders its appearance inelegant, its taste nauseous, and, I should apprehend, must considerably

informed that artichoke stalks, by being gently dried in an oven, lose their property of striking a black colour with chalybeates.

(*a*) THE vapour which exhales in the first coction, being caught in proper vessels, condenses into a limpid liquor which smells strongly of the bark.

Lewis's Mat. Med. p. 431.

GENUINUS cortex, sapore satis grato, et aromatico-amaro est; odorem spirat peculiari modo mucidum, atamen suavem, gratum, et *aromaticum*; atque huic sensui, in corticis sinceritate deprehendenda, præ cæteris omnibus credere soleo.

Morton. lib. 1. p. 66.

ably diminish its efficacy. For as the virtues of the bark are strongest in its native state, they depend in all probability on its composition as a *mixt*; and must of course be impaired by the disuniting of its constituent principles. Intermittents have been cured by oak bark and gentian combined, when neither astringents nor bitters separately, had any effect. By the first, second, and third experiments it appears, that the *cortex* yields its virtues at least as perfectly to cold as to boiling water. And the simple infusion hath certainly many advantages over the decoction. It is a much more agreeable and elegant preparation, and the principles of the bark remain perfectly unaltered in it, retaining the same proportions to each other as in the substance of the drug itself. Nature hath so accurately combined, and blended together the gummy and resinous parts of the *cortex*, that by their union they become soluble in *menstrua*, with which when separated

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they



they refuse to unite. Thus they reciprocally promote the solution of each other in water and ardent spirits; and both the tincture and infusion are found by experiment, to be strongly impregnated with these two constituent principles of the bark. The tincture is without doubt an elegant and palatable medicine; but it is liable to this objection, which indeed holds equally true against spirituous tinctures in general, that a sufficient dose of the medicine cannot be given, on account of the heating nature of its vehicle. This preparation however, might be rendered much stronger, if a larger proportion of bark, than is prescribed by the college of physicians, were to be employed.

### EXPERIMENT XIII.

EQUAL quantities, viz. six ounces by measure of two tinctures of the bark, the one made after the *formula* of the London Dispensary



Dispensatory, the other with double the usual quantity of bark, were weighed with great exactness, in a nice pair of scales; and the latter was found to be eighteen grains heavier than the former, and to exceed in gravity the simple proof spirit thirty seven grains. The stronger tincture had also a considerably deeper hue, and when mixed with water became much more turbid.

IN nervous fevers, hysterical disorders, and other low cases where it is necessary to join cordials to the bark, an infusion of it in red port wine may be prescribed with advantage. Under this form the famous empiric Talbot used to administer the *cortex* in the paroxysms of intermittents; and so successful was his practice, that LOUIS XIV. was induced to purchase at a large price the secret of his specific. Orange peel is an useful ingredient in preparations of the bark; it gives a grateful warmth to the infusion, and

and adds, I think, considerably to its efficacy. The following *formula* is agreeable to the taste, and well adapted to a weak and delicate stomach.

℞ *Pulv. cort. peruv.* ʒj. *cort. aurant.*  
 ʒfs. *aq. cinnamom. ten.* ℥j. *aq. cinnamom.*  
*sp.* ʒij. *m. et infunde sine calore per horas*  
*octo, vel duodecim, deinde filtra.*

THE use of trituration in promoting the powers of solution is evident from experiments IV. VI. and VII; and would have been still more so, if a proper apparatus had been employed. The Count de la Garaye, a French nobleman, who is distinguished for his assiduity in applying the different branches of philosophy to the improvement of medicine, hath described a very convenient machine, and pointed out an admirable process for obtaining from vegetables, by triture with water, the matters in which their virtues chiefly reside.

reside. The contrivance is extremely simple, consisting only of a vessel to which a churning staff is fitted, which by means of a cord and a wheel, is perpetually whirled with a rotatory motion. By this constant agitation the most accurate diffusion is produced, and different portions of the *menstruum* are in quick succession applied to every particle of the solvend.

FROM the 5th. experiment no certain conclusions can be deduced ; except that the extract is a much weaker preparation than is commonly supposed. It is liable to all the objections which have been advanced against the decoction, with this additional one, that it is hardly possible to make it according to the process of the London Dispensatory, without giving it some degree of *empyreuma*. The extract employed in my experiment, was prepared by a very diligent and careful apothecary, yet a considerable portion of it  
presently

presently subsided in a powdery form to the bottom of the glass, which on examination appeared to be the burnt parts of the bark. How little then is this officinal medicine to be depended upon, when we consider the carelessness and inaccuracy of many of our druggists, and apothecaries. (*a*)

IT

(*a*) It were to be wished, that the college of physicians would direct all extracts to be made, by means of a water bath. The following simple contrivance will fully, commodiously, and with very little trouble to the operator, answer this purpose. Let a pan be made of suitable dimensions, with a large circular hole in the cover of it, adapted to receive a china, or glass basin, and with a curved pipe, two inches high, and half an inch in diameter, on one side: the cover should be closely cemented to the pan. Fill the vessel with a sufficient quantity of water; then place the basin in the cavity designed to receive it, and lute it well to the cover. The pan may now be set over a kitchen fire, and the liquor intended for evaporation poured into the china basin. From the closeness of the vessel, the heat which the water acquires will exceed the common boiling point; and the evaporation will be proportionably expedited, without the least danger of producing an *empyreuma*. The pipe will serve the double purpose of conveying



IT is the practice of the most eminent physicians, to join acids with the bark in the cure of putrid diseases; and Sir John Pringle hath observed, that in bilious fevers the *cortex* answered best in Rhenish wine, after standing a night in infusion. (a) This suggested to me the 8th. experiment, and I flattered myself that by macerating the bark in a mixture of vinegar and water, these two antiseptic medicines would be more accurately combined, and that, perhaps the acid might promote the dissolvent power of the aqueous *menstruum*. In the latter expectation it appears that I was disappointed; and whether the former was better founded must be left to abler judges to determine. (b)

THAT

veying a fresh supply of water into the pan, when it is wanted, and of carrying off some part of the steam. If a greater degree of heat be required, the pipe may be closed with a cork.

(a) Diseases of the Army, Edit. 4. p. 213.

(b) Vide Experiments XIX. XXVI.



THAT moderate heat promotes and assists the action of water, as a *menstruum*, on the bark, is evident from experiment the IX; and it would be of advantage to determine what degree of heat this drug will admit of, without suffering a decomposition. It should, however, be remarked, that this infusion though stronger, had neither so agreeable a flavour, nor was so sensibly impregnated with the *aroma* of the bark, as the two made with cold water.

IN an essay on the DISSOLVENT POWER OF QUICK LIME, a very ingenious chemist hath observed, that all resinous bodies become soluble in water, when the cohesion of their particles is destroyed by withdrawing the fixed air which they contain. This method of solution he endeavours to apply to many valuable purposes in medicine; and hath described several useful and curious processes, for obtaining strong and elegant tinctures of  
the

the most active drugs by means of quicklime. The first part of the 10th experiment, *mutatis mutandis*, was borrowed from him; and it was hoped that an efficacious and palatable infusion, might with tolerable expedition be made, by the process which he has laid down. But the success of my experiment was not answerable to the plausibility and ingenuity of the theory, which induced me to attempt it. The infusion after standing twelve hours, the time prescribed by Dr. Macbride, was but weakly impregnated with the bark: and when the maceration had been continued forty eight hours, it by no means equalled in strength the preparation described. Exper. IV. It appears therefore that quicklime, whatever its effect may be upon other medicines, neither quickens nor increases the solubility of bark in water: and it communicates to the infusion a taste which is intolerably nauseous and disagreeable. That the chalybeate solution

lution should produce no change in the colour of these preparations, is agreeable to the laws of elective attraction. For the acid of the vitriol, having a stronger affinity with absorbent earths than with metallic substances, forsakes the iron with which it was combined, and unites itself to the quick lime. Hence arose the yellow, ochery sediment taken notice of in the experiment. As the *residuum* after filtration did not effervesce with oil of vitriol, it is evident that quick lime is not endued with the power of abstracting from bark, the fixed air which it contains.

EXPERIMENT XI. furnishes no other inference than this obvious one, that the decoction and infusion of the bark are calculated only for immediate use. The *cortex* is a substance of a very fermentable nature, as appears from the experiments of Dr. Macbride; and when its active parts are diffused in water, and separated from

from such as are merely ligneous and inert, it is not to be wondered at that it undergoes those changes, to which all vegetables, when favourably circumstanced, are liable.

As it is to be feared that decoctions of the bark, from the facility with which they are prepared, will still continue in use, it may be necessary to suggest, that they should be poured upon the filter as soon as they are taken from the fire. Whilst the water is hot, the resinous part of the *cortex* will continue dissolved in it, and will readily pass through a coarse strainer; but if the *menstruum* be suffered to cool, it will separate, concrete together, and a considerable portion of it will remain in the filter: and thus the efficacy of the medicine will be greatly diminished.



## SECTION II.

**I**T appears from the preceding section, that the PERUVIAN BARK yields its virtues as perfectly to cold as to boiling water; and that the simple infusion in point of elegance and efficacy, is preferable to the decoction. But the latter preparation hath this advantage, that it is made with great expedition: For it is a fundamental principle in chemistry, that heat quickens the action of almost every *menstruum*. To avail myself therefore of this assistance without decomposing the bark, I made the following experiment, in the issue of which it will appear that I was disappointed.

EXPE-



## EXPERIMENT XIV.

A GLASS phial lightly stopped, containing two drachms of powdered bark, well incorporated with three ounces of spring water, was placed in a half pint cup of cold water. The cup was set in a pan of boiling water, and kept in the boiling heat for the space of an hour and half. The phial was then taken out of the vessel, and the heat of it measured by Sir Isaac Newton's thermometer, when it was found to be about eight degrees below the boiling point, which is nearly equal to forty degrees in Fahrenheit's scale. The infusion whilst hot was clear, and of a deep red, but when cold, it assumed a brown colour, and had a turbid appearance.

SEVERAL other experiments were tried, in order to determine what degree of heat the bark will bear without decomposition ;

on; but I was unable to hit upon the precise point. And when I considered that if it could be ascertained, few apothecaries in extemporaneous prescriptions would pay an exact attention to it, I dropt all further attempts towards the discovery of it. But the following experiment, which I have made since the first edition of these Essays, obviates the necessity of using heat, and points out a method of making, with sufficient ease and expedition, a saturated infusion of the bark.

#### EXPERIMENT XV.

Two drachms of the *cortex*, finely powdered, were diligently triturated, fifteen minutes, in a marble mortar, with four ounces of rain water; and afterwards macerated without heat, three quarters of an hour. The infusion was then filtered through paper, and appeared by all the tests used in the preceding  
expe-

experiments, to be considerably stronger than another preparation, which had been macerated twenty four hours. Three ounces of it, by measure, weighed a grain and half more than the infusion, prepared, according to the same proportions, without attrition.

A SIMILAR preparation was made by triturating the *cortex* ten minutes only, and then filtering without digestion. But the *menstruum* was by this method, less impregnated with the bark, as its taste, colour, specific gravity, and the diminished effect of the chalybeate solution, clearly evinced. The elegance, and strength of this preparation is increased, by the addition of a small quantity of French brandy, during the triture.

#### EXPERIMENT XVI.

It is evident from the 7th experiment, that a considerable quantity of the

refin of the bark is soluble in cold water; but I was desirous of trying whether the whole of it might not be dissolved by repeated affusions of the same *menstruum*. For this purpose I macerated half an ounce of powdered bark, for the space of three days, in six ounces of spring water. The *menstruum* was then decanted off, and fresh water added in the same quantity as before. This affusion was repeated at equal intervals thirty times, till the water was insipid, colourless, and unalterable by the addition of green vitriol. The *residuum* also, when chewed in the mouth, had no sensible bitterness or astringency. Two drachms of this *residuum*, carefully dried by a very gentle heat, were infused in an ounce of rectified spirit of wine; and in two days a tincture was produced of an orange colour, and bitter taste.

### EXPERIMENT XVII.

HALF an ounce of powdered bark  
loosely



loosely tied up in a linen rag, was boiled over a quick fire twenty five times, in so many different pints of spring water. Each coction was continued twenty minutes, and repeated till the *menstruum* received no sensible impregnation from the bark. After the twenty fifth boiling, it was perfectly tasteless, struck no black with *sal martis*, and the powder when chewed in the mouth was equally insipid with the liquor. Two drachms of the *residuum*, cautiously dried, were digested forty eight hours, in an ounce of *sp. vin. rectificat.* The spirits acquired a deeper colour, and were more strongly impregnated with the bitterness of the *cortex*, than in the preceding experiment. But neither this, nor the former tincture, struck a black with green vitriol, owing perhaps to the insolubility of that metallic salt in rectified spirit of wine.



## EXPERIMENT XVIII.

A DRACHM of powdered bark was digested without heat forty eight hours, in two ounces of rectified spirit of wine. The clear tincture was then poured off, and fresh spirit, in the same quantity as before, was added to the *residuum*. The digestion was thus repeated six times, until the *menstruum* acquired neither taste nor colour from the bark. The powder was then carefully dried, and afterwards successively macerated, without heat, in two several portions of spring water; to each of which it communicated the property of striking a purple colour with green vitriol. Both these infusions were insipid; so that rectified spirit seems to have the power of extracting all the bitterness of the *cortex*, though not all its astringency. Is not this fact repugnant to what Dr. Lewis hath observed of this drug, “ that its  
astrin=

astringency resides wholly in its resin, which does not appear to be in any degree soluble in watery liquors?" (a) The same ingenious writer is likewise mistaken, when he asserts that the resin of the bark melts out in the first boilings, and that the subsequent decoctions are transparent and bitter, without the least turbidness or astringency. (b) For in making the 17th experiment, I found the decoction after the twentieth boiling, struck a purple colour with *sal martis*. The three last trials furnish a striking proof of the slow and difficult solubility of the bark. Fuller says with some degree of admiration, *Cum olim experimenti causa ejusdem (corticis) pulverem sæpius decoxissem, non eo usque vires ejus exhaurire valui, quin vel octavum decoctum adhuc amaricaret.* (c) If his patience had permitted

(a) Neumann's Chem. by Lewis, p. 339. Note (x)

(b) Ibid.

(c) Fuller. Pharm. Extemp. p. 5.

mitted him to extend his experiment, what would have been his surprise to find, that even twenty five coctions, and thirty cold macerations, are insufficient to exhaust the virtues of the *cinchona*? An ingenious friend of mine informs me, that he reduced the bark, by extraction and decoction, to an insipid powder, which was given in the dose of two drachms, to a patient labouring under a quotidian fever, an hour or two before the accession of the paroxysm. It mitigated the fits by degrees, changed the quotidian into a tertian, and then entirely removed it.

### EXPERIMENT XIX.

IN order to determine with more accuracy the relation which different *menstrua* bear to the bark, I digested a drachm of the *cortex*, weighed with great exactness in equal quantities, viz. three ounces of each of the following liquors. 1. spirit  
of

of wine rectified. 2. French brandy. 3. Rhenish wine. 4. cold water. 5. cold water with the addition of a drachm and half of white wine vinegar. After seven days infusion, the clear part of each *menstruum* was carefully poured off, and the *residuum* evaporated to dryness. The weight which the bark lost by digestion is expressed in the following table, which shews the comparative powers of solution of the several liquors mentioned above.

*Cort. Peruv.* 3j. infused seven days in

		Grains.
<i>Sp. vin. rectificat.</i>	lost	6
<i>Sp. vin. gallic.</i>	—	8 $\frac{1}{4}$
Rhenish wine	—	9
Water	—	8
Water and vinegar	—	8

RHENISH wine, from this experiment, appears to be the most active *menstruum* for the bark. Whether it owes any part of its superior solvent power to the acid  
with



with which it is replete, cannot with certainty be determined ; but I am inclined to think it doth not, because the solution of the *cortex* is not in the least promoted by the addition of vinegar to water. Dr. Lewis says, that proof spirit extracts less from bark than rectified spirit ; (a) but from the preceding trial, which was made with all possible exactness, it is evident he is mistaken. This experiment likewise affords the most satisfactory proof, that cold water is a powerful *menstruum* for the *cinchona*. It is considerably more active than rectified spirit of wine, and is very little inferior to brandy. Perhaps the *residuum* of the watery infusion would have weighed less, if the maceration had been continued only two days : for water, after extracting from bark all that it is capable of dissolving, precipitates some part of it again.

EXPE-

(a) Mat. Medica. p. 432.



## EXPERIMENT XX.

Two drachms of gentian root were macerated forty eight hours, in three ounces of cold spring water: the same quantity was boiled over a quick fire in four ounces of water, till a fourth part was consumed. The infusion had a more intensely bitter, and at the same time a much less disagreeable taste than the decoction, which was mucilaginous, and highly nauseous. Six grains of *sal martis* were added to each; but neither of them changed colour. The same experiment was repeated with Aleppo galls. The decoction manifested more roughness and astringency to the taste, than the infusion, but did not strike so black a colour with green vitriol. Dr. Lewis informs us, that by steeping the *carduus benedictus* for a few hours in cold water, a very agreeable bitter is procured; but if heat be employed, the more ungrateful parts of the  
plant

plant are taken up, and the infusion becomes so nauseous as to provoke vomiting. If fena be infused in cold, or for a little time in warm water, the liquor will purge far more mildly than an infusion made in hot water for a longer time, though both infusions be reduced to the same degree of strength, by a suitable evaporation. (*a*) Camomile flowers, as I have long experienced, have their bitterness very perfectly extracted by cold maceration; and in this way they they are much more grateful, than when infused in boiling water. An ounce of flowers, and half an ounce of orange peel, macerated in three pints of water for twenty four hours, make a light, cheap, and agreeable stomachic medicine. Green and bohea tea yield a finer flavour to a cold than hot infusion, and they strike as deep a black by the former, as by the latter method of preparation. Oak bark,  
it

(*a*) Vide Neumann's Chem. p. 267.

it is well known, is always steeped in cold water for the purpose of tanning: and I suppose the artists in that branch of trade, find that the application of heat is not necessary to extract its astringency. May we not therefore justly conclude from the preceding experiments and observations, that cold water is a more universal and powerful *menstruum*, than hath hitherto been apprehended; and that its use in pharmacy is at present too much overlooked and neglected.

THE result of the 8th experiment was so contrary to my expectations, that I determined to make further trials of the effects of acids, in destroying that property in certain vegetable substances, by which they strike a black colour with chalybeates, which hath been long regarded as an indubitable test of astringency.

EXPE-

## EXPERIMENT XXI.

AN ounce of the infusion of camomile flowers was divided into two equal portions; to one was added a drachm of white wine vinegar, to the other an equal quantity of spring water. Thus with respect to dilution they were precisely in the same circumstances. A tea spoonful of the solution of *sal martis* was then mixed with each of them. The portion which contained the vinegar, suffered no change of colour; the other instantly assumed a dusky hue. The same experiment was repeated with a very strong triturated infusion of the bark, and the result was nearly the same. As soon as a drachm of the vinegar was added to half an ounce of the infusion, it changed the colour of it from a deep and reddish brown to a bright yellow; whilst the same quantity of water, had no sensible diluting effect on the other portion with  
which



which it was mixed. The chalybeate solution, as in the former experiment, was then added. It produced no alteration in the portion with vinegar, but the other it changed into a perfect ink.

### EXPERIMENT XXII.

To half an ounce of a strong infusion of galls were added two drachms of the solution of *sal martis*. It presently assumed the appearance of ink. Forty drops of the acid of vitriol restored it to its original colour. Thirty drops of the *sp. c. c. vol.* renewed the inky blackness.

IN these experiments it is obvious that an affinity subsists between acids, astringents, and bitters; and this suggested to me that they may possibly neutralize each other, and when combined together in due proportion, form what the chemists term a *tertium quid*. This important point, from which many useful inferen-



ces may be deduced, I attempted to ascertain in the following manner.

### EXPERIMENT XXIII.

To half an ounce of a light infusion of the bark I added twenty drops of white wine vinegar. The acid and the bitter entirely corrected each other, and a new taste was induced : after standing twelve hours, the mixture changed from a light yellow to a deep chocolate, and deposited a large brown sediment.

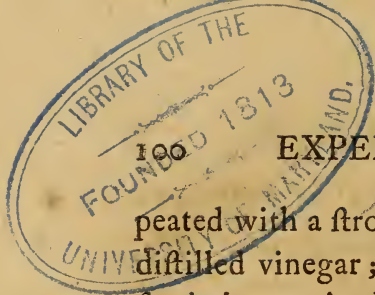
### EXPERIMENT XXIV.

THE same quantity of vinegar was added to half an ounce of an infusion of Aleppo galls. The mixture was more austere, and astringent to the taste than the infusion. After standing twelve hours, it deposited a flocculent, whitish sediment, and the liquor above became less austere to the taste than the simple infusion itself.

EXPE-

## EXPERIMENT XXV.

To equal quantities of spring water and of a strong infusion of gentian root, in separate glasses, was added one drachm of white wine vinegar. The acid was entirely covered by the infusion, but the spring water was manifestly sour to the taste. Sixty drops of the syrup of violets were then added to each. The infusion suffered no change of colour; but the water assumed a light red, inclining somewhat to purple. Imagining that the deep colour of the infusion prevented me from perceiving the action of the acid on the vegetable blue, I took the same quantity of old Mountain Wine, which was precisely of the colour of the infusion of gentian, and adding to it a drachm of vinegar, and sixty drops of syrup of violets, I found a slight purple redness manifest itself about an hour after the mixture. The same experiment was re-



## EXPERIMENTS ON

peated with a strong infusion of galls and distilled vinegar; but the result was not so obvious as in the former one, probably on account of the weaker powers of the acid employed.

### EXPERIMENT XXVI.

SIR JOHN PRINGLE hath proved that neutral salts resist putrefaction with considerably less force, than the acids and alkalis of which they are composed. *Spiritus mindereri*, for instance, is not half so antiseptic as the *sal. c. c. vol.*: and the common saline mixture of *sal absinth.* and *succ. limon.* is only three fourths as antiputrescent as salt of wormwood separately taken. (a) Dr. Macbride also hath demonstrated, that acids and alkalis have the power of restoring sweetness to putrid substances, but that when mixed together to the point of saturation, they lose this property.

(a) Diseases of the Army, Append. Exp. 5th. 9th.

property. (*a*) As there seems therefore, by the three foregoing experiments, to be an analogy between the combination of acids, astringents, or bitters, and acids and alkalis, curiosity induced me to pursue it; and I flattered myself, that though my attempts should prove unsuccessful, some useful facts might offer themselves to my notice, and that my labour would not be without its reward.

AN ounce and half of mutton, chopped very small, was divided into five equal parts, and put into so many different phials. To the first, which was designed for a standard, were added twelve drachms of spring water; to the second, ten drachms of water, and two drachms of white wine vinegar; to the third, ten drachms of the decoction of the bark, and two drachms of vinegar; to the fourth, ten drachms of the decoction of

H 3

the

(*a*) Macbride's Essays, p. 129.



the bark; to the fifth, ten drachms of water and one scruple of bark finely powdered. The bottles were lightly stopped, and set in a sand bath, the heat of which was regulated by a thermometer, and kept up to the hundredth degree of Fahrenheit's scale. In the night the lamp was suffered to go out. The changes as they occurred in the mixtures were carefully noted down, and were as follows.

THE standard phial in seven hours emitted many air bubbles, and was frothy at top; but had acquired no fetor; No. 4. the decoction of the bark was also a little frothy. The next day the standard smelled offensively, and No. 4. was just perceptibly tainted. The third day, the standard was very fetid; No. 4. was evidently putrid. The fourth day, the standard was so extremely offensive that I removed it. No. 2. the vinegar and water, was not quite sweet. No. 3. the decoction



tion of the bark and vinegar, was unchanged. No. 4. the decoction of the bark, was very fetid. No. 5. the powder of bark and water, was quite sweet but a little mouldy. The 5th day, No. 2. the vinegar and water, was more offensive than before. No. 4. the decoction of bark, was so putrid that I removed it. No. 3. and 5. were quite sweet.

THE sixth day. The phials were removed from the sand bath yesterday, on account of an accident which happened to the lamp; and they remained in the cold for twenty hours. This morning they were set by a warm fire. They were not much changed since the last examination.

THE seventh day. No. 2. the vinegar and water, was very offensive, but had a peculiar feter, totally different from the putrid smell of No. 1. and No. 4. It

H 4

was

was therefore removed. No. 3. and No. 5. were sweet.

THE eighth day, No. 3. the decoction of bark and vinegar, was a little tainted. No. 5. the powder of bark and water, was perfectly sweet, and did not become sensibly putrid till the thirteenth day from the time of mixture.

### EXPERIMENT XXVII.

To an ounce of putrid ox gall were added an ounce and half of the decoction of bark, one drachm of the powder of bark, and three drachms of white wine vinegar. The putrid smell of the gall was entirely corrected; and the mixture continued sweet fourteen days, though it was placed near a warm fire.

IN the event of the two last experiments I was very much deceived. Before I undertook them I was almost fully  
persuaded,

persuaded, that there subsisted a compleat analogy between the combination of acids, astringents or bitters, and acids and alkalis; and that the neutrals formed by the mixture of the former, like those of the latter, would prove less antiseptic than the substances separately taken of which they are composed. This preconceived hypothesis led me to suspect the present practice of joining acids and the bark, in the cure of putrid diseases, to be very improper, as I imagined they would counteract each others effect. To ascertain this important point, I made the two preceding experiments with the most minute exactness; and though the result of them was the very reverse of what I had supposed, I was neither mortified with my disappointment at that time, nor am I now ashamed to acknowledge it. In a long course of experiments, which are undertaken with some particular view, and not made at random, instances of self deception frequently and unavoid-

unavoidably occur. And in general they happily serve as a spur to industry. We first conceive a fact, and then set about the demonstration of it. If the trial succeed, our end is obtained, and for the most part we rest satisfied. But if the proof fail, some unexpected phenomena oftentimes occur, which awaken our attention, and excite us to new pursuits. But whether this be the case or not, success or disappointment are equally useful in experimental enquiries; because a negative truth may be of as much importance as a positive one.

THE five last experiments furnish, at least, a presumptive proof, that acids and astringents or bitters, neutralise each other. By mixture it appears their taste and smell are altered; the acids lose their property of striking a red colour with syrup of violets; and their antiseptic powers in combination, are double the sum of them when separately employed. The  
bark

bark likewise with vinegar [Exper. 27.] hath the power of restoring sweetness to putrid substances, which it hath not alone, as Dr. Macbride affirms. (*a*) Sir John Pringle hath indeed asserted the contrary; but in his experiment the putrid alkali seems to have been washed off, not corrected, by repeated affusions of the decoction of the bark.

### EXPERIMENT XXVIII.

Four pieces of calf skin, fresh stripped from the calf, and exactly of equal sizes, were immersed, one in an ounce and half of the infusion of bark; the second in an ounce and half of the same infusion, with two drachms of white wine vinegar; the third in an ounce and half of the infusion of Aleppo galls; the fourth in an ounce and half of the infusion of galls, with two drachms of vinegar.

At

(*a*) Macbride's Experimental Essays, p. 130.



At the end of seven days they were taken out, and carefully examined. The pieces which had been immerfed in the infufions of galls, and bark with vinegar, were much fofter and more fwoln, efpecially in the middle, than the other two pieces: and the cuticle very eafily feperated from the cutis, which was not the cafe with the others. So that the acid feemed greatly to diminifh the aftriictive powers of thefe two infufions. The pieces were all fo shriveled, that I could not eafily meafure them, nor determine which was the moft contracted in fize.

VINEGAR, it is well known, hath the property of foftening animal fibres in a very remarkable degree; and diluted with warm water, it is frequently employed as a refolvent in external, topical inflammations. But when taken internally, or applied to any very fenfible membrane, it acts as an aftringent. Thus in the mouth  
it

it corrugates the tongue and palate, and induces a paleness in the lips, by contracting the small capillary arteries which run upon their surface. And when injected into the *vagina*, it proves an excellent remedy in the *fluor albus*, but requires in some cases, to be diluted with water, otherwise it would be too suddenly astringent and corroborant. On what principles it is that it produces such opposite effects on the dead and living fibre, it would be difficult with certainty to determine. Perhaps its astringent property may depend upon its stimulus, which can only exert itself on the *solida viva*; as the simple solids are the proper subjects of its resolvent power. But although the preceding experiments clearly prove, that vinegar in combination with astringents, diminishes their corrugating effects on the dead fibre; I would by no means infer, that its action is the same when applied to the living fibre, or that acids and the bark are improperly exhibited

exhibited together in the cure of hemorrhages. From the 24th experiment it appears, that the infusion of galls is rendered much more austere to the taste by the addition of vinegar; and it is not improbable, that its astringent power as a medicine is increased in the same proportion. For I apprehend that the taste, with respect to the operation of this class of vegetables on the body, is the least fallacious test of astringency. I term it the least fallacious test, because it will be shewn afterwards, in the succeeding section, that neither the taste, nor the property of striking a black colour with chalybeates, nor yet the power of hardening animal fibres, whether separately or collectively taken, are certain criteria of the astringent power of a medicine on the living body. (*a*)

I SHALL

(*a*) WHEN the 28th experiment was made, it did not occur to me to try the effects of the mineral acids, in conjunction with the vegetable astringents. But I have

I SHALL conclude this section with a few obvious, practical inferences, from the foregoing observations and experiments.

1. IT is the opinion of a very eminent physician, that the bark, when taken in substance, disagrees with weak stomachs, on account of its fermenting quality. (*a*) But I think the 16th. 17th. and 18th. experiments, which prove its remarkably slow solubility, furnish a better explanation of the fact. When the stomach is overloaded with a dose of the *cortex* in powder, a sense of weight and oppression, not of flatulency or distension, is for the most part complained of. And it is a common, and I believe useful

have since found by an experiment, made with the decoction of the bark and elixir of vitriol, that the astringent power of the former is much increased by the addition of the latter.

(*a*) Pringle's Dis. Army. Append. p. 66.



useful practice, to join aromatics with the bark, and that doubtless with a view to stimulate the digestive powers, and quicken its passage through the *primæ viæ*. For as it is evident from the experiments of Sir John Pringle himself, that they are of a very fermentable nature, they cannot correct, but must rather promote that tendency in the *cortex*, and add to the uneasiness which it occasions by the fresh generation of air. But the best proof that the bark is not so prone to run into fermentation, and that it is in some stomachs almost indigestible, is the case of a patient of the late Dr. Alston, who vomited up a dose of it almost unchanged eight days after taking it. (a) A very ingenious friend of mine hath remarked in the course of his practice, that the bark in substance is less oppressive when given in draughts, than either in the form of a bolus or electuary.

(a) Cullen's Lect. on the Mat. Medica.



electuary. A considerable quantity of unfixed air, he says, adheres to the particles of the powder, which occasions disturbances when carried into the stomach. By combining the *cortex* with any liquid, this air is in a great measure, he thinks, separated, as appears by the bubbles which are formed, and the frothyness which is produced during the act of mixture.

THE fact is curious, and I doubt not perfectly true; but the explanation of it is more plausible than satisfactory. The bark when administered in draughts, is generally mixed with some agreeable aromatic water, which renders it more palatable, dilutes it in the stomach, and by its grateful warmth promotes the more speedy digestion of it. But when given in a bolus or electuary, which are for the most part made up with syrups, it is peculiarly nauseous, owing probably to the unpleasant combination of sweet

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and

and bitter. And it is a common observation, that what is disgusting to the palate, is generally offensive to the stomach. The more solid form of these two preparations is likewise unfavourable to quick solution. Soap pills have been known to pass through the whole intestinal canal undissolved. In a weak state therefore of the stomach and bowels, we need not wonder that a large mass of an electuary of the bark, should lie long unchanged, and prove very oppressive.

2. As it appears from several experiments, that bitters have the property of neutralising acids, their use in acidities of the first passages is very obvious. In such cases indeed they may be considered as indicated on a double account, to correct the disease when present, and by their bracing and corroborant effects to remove the cause, and prevent the return of it. When given with such intentions, they

they should be infused in brandy, or in some of the stronger wines. It has been long the practice to exhibit bitters in icterical complaints, as a substitute for the bile. But though with this view, they are improperly employed, as being antiseptic, retarders, and moderators of fermentation, and consequently very different from the bile, which is possessed of all the opposite qualities; yet I cannot join with a very celebrated physician in opinion, that they do little or no service in the jaundice. (a) This disease, when it has been of some standing, is almost always accompanied with loss of appetite and indigestion, and with acidities and flatulencies in the *primæ viæ*. The stomach and bowels, from the defect of bile, are deprived of their usual *stimulus*, their peristaltic motion is impaired, and the food, by long stagnation, runs with violence through its successive stages of fermentation.

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mentation.

(a) Pringle's Append. to Dis. Army. p. 72.

mentation. In this state of the distemper, the *saliva* and *succus pancreaticus* probably acquire a morbid disposition, and instead of assisting digestion, and checking the generation of air, serve rather to injure the one, and promote the other, increasing the general tendency to sourness and crudity. Under these circumstances, evacuants, antacids, and antifermentatives are certainly indicated. Vomits and purgatives answer the first, and bitters the two last intentions. The former are adapted to remove the cause of the disease; the latter only to palliate some of its most troublesome symptoms. In this view however they are of importance; and the use of them should by no means be discouraged.

3. In a posthumous work of the learned Dr. Boerhaave, published by his pupil Van Eems, it is asserted, that the deleterious effects of scammony, colocynth, and spurge, are corrected by vinegar. (*a*)

These

(*a*) Boerhaave de Morb. Nor. Cap. de Paralyfi.



These are all vegetable bitters, and probably the action of the acid consists in neutralising them. If this be the case, the use of vinegar as an antidote, may perhaps be more extensive than is commonly supposed. For many of those substances, which on account of their virulent and pernicious effects on the body, are termed poisons, have a considerable degree of bitterness; as may be instanced in the *lauro cerasus*, *nux vomica*, *belleborus*, *nicotiana*, *camphor*, *opium*, *euphorbium*, *asarum*, *bryonia*, *coloquintida*, *elaterium*, *chelidonium majus*, &c. And it is at least as probable, that their noxious qualities reside in their bitter, as in any other part of their composition. (a)

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4. DR.

(a) ON communicating this conjecture to my ingenious and learned friend Dr. Dobson of Liverpool, he furnished me with the two following experiments in confirmation of it.

EXPE-



4. DR. HILLARY, in his treatise on the  
Yellow Fever of the West India islands,  
discom-

## EXPERIMENT I.

" May 21, 1764. Twelve grains of Opium, dissolved in half an ounce of water, were given to a Pointer Bitch, which weighed twenty five pounds and two ounces. The natural state of her pulse was from 110 to 115 pulsations in a minute; and it should be premised, that in making the following experiments, I never examined the pulse, but after she had been in my room 15 or 20 minutes, and was either asleep or lay at rest.

Soon after giving her the opium, she looked heavy; flavered a great deal; and appeared to be much offended with the taste of the opium.

When at liberty, she went out into the open air, but was dull and moved slowly.

ONE HOUR AFTER; Pulse 75. Very uneasy and distressed. An universal rigor and trembling every five or six seconds.

TWO HOURS AFTER; Pulse 60. Had run out into the street for half an hour; head rather giddy, with an unsteadiness in her gait; complains and groans frequently; heavy, but does not sleep much; flavers a great deal.

THREE HOURS AFTER; Pulse 59. In other respects much the same.

FIVE HOURS AFTER; Pulse 60. Had been in the open air for more than an hour; rather staggered as she went down some steps; frequently kept her head very erect,  
but

discommends the use of the bark in that disease, chiefly on account of its disa-

I 4 greement

but not steady; slept very little; lost all her playfulness; flavers; refuses to eat bread; offended with the taste of the opium; and has still the tremblings and twitchings.

EIGHT HOURS AFTER; Pulse 80. More brisk, and seems to be coming to herself again.

TWELVE HOURS AFTER; Pulse 86. Had followed the servant for more than a mile; still more herself.

SIXTEEN HOURS AFTER; Pulse 113. Not much different from her usual appearance.

## EXPERIMENT II.

May 28th, 1764. Twelve grains of opium dissolved as in the former experiment, and with the addition of 30 drops of the acid elixir of vitriol, were given to the same Pointer. Much offended with the taste; foams and flavers.

ONE HOUR AFTER; Pulse 90. Slavers very little; alert as usual. As she lay asleep in my room, she had a little rigor and trembling.

TWO HOURS AFTER; Pulse 85. There were now given her 20 drops of the elixir of vitriol in an ounce of water; flavered a little after this.

THREE HOURS after; Pulse 80. The slaving soon ceased; is not near so much offended with the taste of the opium as in the former experiment. Rigor and trembling very observable, but only when asleep: 30 drops of elixir

greement with the stomachs of his patients. He acknowledges however, that it is strongly indicated, and seems to lament, that even under the pleasanterest form it cannot be retained. But from the 27th experiment I should conclude, that

elixir of vitriol were now given; and one hour after this, 20 drops more; so that she has had in all 100 drops of the elixir of vitriol, within the four hours.

FIVE HOURS AFTER; Pulse 95. Brisk; some of the twitchings, but only when asleep.

EIGHT HOURS AFTER; Pulse 120. Not much different from her usual appearance; some very slight twitchings as she lay asleep.

These and some other experiments were made, in order to ascertain the efficacy of acids in counteracting the deleterious qualities of opium. When an over dose of opium has remained in the stomach for some time, the sensibility of that organ is almost entirely destroyed, so that the most active emetics are ineffectual to evacuate the poison. It is a matter of consequence therefore in this case, to know what class of medicines we may next have recourse to, with the greatest probability of success. As the opium cannot be rejected from the stomach, relief is only to be expected from such remedies as will change the nature of the opium itself: and how far this end is to be attained by the liberal use of acids, the reader may judge by comparing these two experiments."

that it would sit tolerably easy, or at least that it would not be rejected, if it were combined with the vegetable acids. A redundance and corruption of the bile are the pathognomonic symptoms of this fever; and notwithstanding the incredible evacuation of it in the first stage of the distemper, there still continues through the whole course of it, both an inordinate secretion of that humour in the liver, and a depravation of it in the first passages. In such circumstances, the bark given by itself cannot fail to disagree; for when mixed with putrid gall, it is observed greatly to increase the fetor of it. (*a*) But when joined with acids, which have the power of neutralizing the corrupted bile, as will hereafter be proved, it can occasion no disturbance, and must be highly serviceable, not only as an antiseptic, but also as a corrobo-

(*a*) Macbride's Essays, p. 140.

corroborant. The truth of this remark is confirmed, even by the practice of Dr. Hillary himself, who exhibits an infusion of snake root as a substitute for the *cortex*, and accompanies it with the elixir of vitriol.



## SECTION III.

**H**AVING frequently observed, during the course of my experiments, that the astringency and bitterness of vegetables are distinct and separate properties, I was desirous of tracing their differences, and of ascertaining the proportion which they reciprocally bear to each other. To this end I made a variety of trials, and though not with all the success that I wished or expected, yet as they throw some light on this intricate subject, I shall here faithfully relate such of them, as were most conclusive and satisfactory.

## EXPERIMENT XXIX.

To equal quantities of strong infusions  
of

of Aleppo galls and gentian root, were added two drachms of a solution of green vitriol. The infusion of galls instantly struck a deep, inky blackness: that of the gentian root was unaltered in colour. The former it is well known is very slightly, the latter very intensely bitter.

### EXPERIMENT XXX.

To equal quantities of strong infusions of rue, wormwood, gentian, green tea, bohea tea, bistort, and galls, was added a tea spoonful of the solution *sal martis*. The galls assumed the deepest black; the infusion of bistort was next in degree; then followed the green and bohea tea, between which I could perceive no difference; the tinge of the wormwood and rue was a little deepened, but the gentian was unaltered. Their degrees of bitterness were in the following order;

1. gentian.
2. wormwood.
3. rue.
4. green and bohea tea.
5. bistort.
6. galls.

6. galls. The two last were very slightly bitter. Twenty drops of white wine vinegar discharged the colour, induced by the green vitriol on the infusions of rue and wormwood: a hundred drops considerably diminished the blackness of the infusions of galls, bistort, and bohea tea. But the first, after standing twenty four hours, recovered its inky colour, and a number of fine, jet black flakes floated about in it, without subsiding: The colouring particles of the two last, much diminished in their blackness, sunk to the bottom of the glasses. Twenty drops of oil of vitriol entirely discharged the black colour of the green tea, and it continued clear and pellucid.

### EXPERIMENT XXXI.

To determine the comparative anti-septic powers of bitters and astringents, I put into ten phials marked 1. 2. 3. &c. a drachm and half of mutton, which had  
been

been kept several days, but was perfectly sweet. To the first, which was intended for a standard, was added an ounce of spring water; to the second, an ounce of a cold infusion of green tea; to the third, an ounce of an infusion of common wormwood; to the fourth, an ounce of the decoction of the bark; to the fifth, an ounce of the infusion of galls; to the sixth, an ounce of a cold infusion of the bark; to the seventh, an ounce of a cold infusion of rue; to the eighth, an ounce of a cold infusion of bistort; to the ninth, an ounce of a cold infusion of bohea tea; to the tenth, an ounce of a cold infusion of gentian. By mistake only the five first phials were placed in the sand bath, the other five were left in my study window, which has a northern aspect. I was called from home, and was absent three days and a half. On my return, I found No. 1. 2. 3. 4. the standard, the green tea, the wormwood, and the decoction of bark, were

were all putrid, but in different degrees, according to the order in which they are marked down. No. 5. the infusion of galls was unchanged. The mixtures, which had been left in my study window, were quite sweet; but they seemed to have some little fermentative motion in them. They were placed in the sand bath, and the next day I examined them. No. 7. the infusion of rue was very offensive. No. 6. the infusion of bark was putrid, but in a less degree than the rue. No. 5. 8. 9. 10. were all sweet. The day following No. 9. the infusion of bohea tea was very putrid. No 8. the infusion of bistort was a little tainted. No. 5. the infusion of galls, and No. 10. the infusion of gentian, continued sweet; and as they remained unchanged several days longer, I removed them from the sand bath, fully satisfied with the proof of their strong antiseptic powers.

EXPER-



## EXPERIMENT XXXII.

EIGHT pieces of calf skin, just stripped from the calf, and exactly of equal sizes, viz. two inches long, and an inch broad, were severally immersed in an ounce and half of each of the following preparations. 1. *decoct. cort. peruv.* 2. cold infusion of the bark. 3. cold infusion of galls. 4. cold infusion of gentian. 5. cold infusion of green tea. 6. cold infusion of bohea tea. 7. cold infusion of rue. 8. Simple water as a standard. At the expiration of a week, they were taken out and examined. The piece in the water was soft and putrid. That in the infusion of rue was sweet but soft. Those in the infusions of green and bohea tea, were hard and curled up; nor did there appear to be any sensible difference between them. The infusion of gentian seemed to possess no inconsiderable degree of astringency;

gency; for the piece of skin immersed in it, was nearly as hard, and as much shriveled, as those in the infusions of green and bohea tea. The decoction and infusion of the bark were, to all appearance, alike in their degree of astringency, which was rather greater than that of tea, but much inferior to the galls.

THIS experiment affords a striking proof, of the difference between the action of a medicine on the dead, and on the living fibre. Tea, when applied to the former, is manifestly astringent; and yet when received into the stomach, it is highly debilitating and relaxant, and the immoderate use of it is attended with the most pernicious effects. It is curious to observe the revolution which hath taken place, within this century, in the constitutions of the inhabitants of Europe. Inflammatory diseases more rarely occur, and, in general, are much less rapid and violent in their progress, than

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formerly.

formerly. (*a*) Nor do they admit of the same antiphlogistic method of cure, which was practised with success a hundred years ago. The experienced Sydenham makes forty ounces of blood, the mean quantity to be drawn in the acute Rheumatism; whereas this disease, as it now appears in the London Hospitals, will not bear above half that evacuation. Vernal intermittents are frequently cured by a vomit and the bark, without venæsection; which is a proof, that, at present, they are accompanied with fewer symptoms of inflammation, than they were wont to be. This advantageous change however is more than counterbalanced, by the introduction of a numerous class of nervous ailments, in a great measure unknown

(*a*) THE decrease in the violence of inflammatory diseases may, perhaps in part, be ascribed to the present improved method of treating them. Moderate evacuations, cool air, acescent diet, and the liberal use of saline and antimonial medicines, are better adapted to check the progress of fevers, than copious bleedings, stimulating purgatives, and profuse sweats, excited by *theriaca* or mithridate.

known to our ancestors, but which now prevail universally, and are complicated with almost every other distemper. The bodies of men are enfeebled and enervated, and it is not uncommon to observe very high degrees of irritability, under the external appearance of great strength and robustness. The hypochondria, palpitations, cachexies, dropies, and all those diseases which arise from laxity and debility, are in our days endemic every where; and the hysterics, which used to be peculiar to the women, as the name itself indicates, now attacks both sexes indiscriminately. It is evident, that so great a revolution could not be effected, without the concurrence of many causes; but amongst these, I apprehend, the present general use of tea holds the first and principal rank. The second place may perhaps be allotted to excess in spirituous liquors. This pernicious custom, in many instances at least, owes its rise to the former, which by the lowness and



depression of spirits it occasions, renders it almost necessary to have recourse to what is cordial and exhilarating. And hence proceed those odious and disgraceful habits of intemperance, with which too many of the softer sex of every degree, are now, alas! chargeable.

FROM the 27th. and 29th. experiments it appears, that green and bohea tea are equally bitter, strike precisely the same black tinge with green vitriol, and are alike astringent on the simple fibre. From this exact similarity in so many circumstances, one should be led to suppose, that there would be no sensible diversity in their operation on the living body. But the fact is otherwise. Green tea is much more sedative and relaxant than bohea; and the finer the species of tea, the more debilitating and pernicious are its effects, as I have frequently observed in others, and experienced



enced in myself. (*a*) This seems to be a proof, that the mischiefs ascribed to this oriental vegetable, do not arise from the warm vehicle by which it is conveyed into the stomach, but chiefly from its own peculiar qualities. (*b*) And these qualities probably accompany the highly flavoured parts of the leaves, and depend upon the nicety and care observed in the

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(*a*) I HAVE now under my care a lady, of a most delicate constitution, who has been long subject to a *profluvium mensum*, to frequent diarrhœas, and to copious and sudden discharges of urine. Bohea tea, of a moderate degree of strength, seldom fails to check the *catamenia*, and she has used it for this purpose ten or twelve months. Green tea, whenever she drinks it, produces tremors, anxiety, and a large flux of urine, which she voids in the quantity of two or three pints at once. The bladder is not over distended, previous to the discharge; but she feels (to use her own expression) as if the urine flowed from all parts of her body to the kidneys, during the time of micturition. It should be remarked that this lady never uses bohea tea, but at a particular period, medicinally.

(*b*) *THEÆ* infusum, nervo musculove ranæ admotum, vires motrices minuit, perdit.

Smith Tentamen Inaug. de actione musculari,

p. 46. exp. 36.

collection and preparation of them. When fresh gathered, they are said to be narcotic, and to disorder the senses; and the Chinese cautiously abstain from the use of them, till they have been kept for twelve months. (*a*) It is remarkable that only one species of the tea plant is yet discovered, and that all the varieties of this dietetic article of commerce, are owing either to the difference of climate, or to the diversity in the method of curing it. The fine green teas, which are the first crop of the shrub, are gathered with the utmost caution, and dried with the gentlest heat, that their perishable flavour may be preserved. The bohea teas are more hastily exsiccated, and even slightly parched over the fire, by

(*a*) Neumann's Chemistry, p. 376.

A GENTLEMAN of veracity, who commanded an East India ship several voyages to China, says that the Chinese rarely drink the green tea; and that those who drink it to excess, are thrown thereby into a diabetes, or become tabid, and die emaciated.

*Vid.* Med. Museum, vol. 2. p. 51.

by which they acquire that brown colour which distinguishes them. And as their more volatile parts are dissipated by this management, they become proportionably less injurious to the nervous system.

An ingenious physician, who has done me the honour to adopt my sentiments, and to quote my arguments against the use of tea, in his Inaugural Dissertation, published at Leyden, 1769, has confirmed my testimony by the following experiments. (a) “ He injected into the cavity  
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(a) DISSERTATIO Medica Inaugularis, sistens Observationes ad vires Theæ pertinentes, auctore J. C. Lettsom. As this Dissertation is proably but in few hands, the following extracts from it, which contain his experiments at large, may not be unacceptable to my learned reader.

#### EXPERIMENTUM I.

SUMPSI infusionis Theæ viridis, & Boheæ, liquoris post distillationem superstitis; nec non aquæ simplicis cujuslibet æqualem quantitatem, & in quemlibet liquorem, in vase suo contentum, immisi drachmas duas carnis bovis, ante duos dies mactati.

Caro bovina, immersa in aquam simplicem, post quadraginta octo horas corrupta, putridaque devenerat; dum  
portiones

of the abdomen, and into the cellular membrane of a frog, about three drachms  
of

portiones carnis in reliquas tres Theæ infusiones immiffæ, post feptuaginta demum horas putredinis indicia monstrabant.

## EXPERIMENTUM II.

VIRIDIS atque Boheæ Theæ, faturatis infusionibus addidi æquales portiones falis martis, & protinus utrumque infufum colorem æqualem, profunde nigrum, adquirebat.

Ex enarratis experimentis tuto concludere licet, Theam & viridem & Boheam manifesta virtute antifeptica, ac adstringente in fibris mortuis, & vi vitali carentibus, gaudere; verumtamen propria, & etiam aliorum, experientia edoctus, certus fcio, eam, in ventriculum ingeftam, præfertim in fubjectis tenerioris & delicatioris compagis solidæ, infignem potestatem relaxantem exferere.

1. Potum hunc ufitatum forma aquæ calidæ, aut fervidæ, fumendi mos invaluit, & inde nonnulli deducere voluerunt effectum, atque vim debilitantem potius huic vehiculo, quam herbæ ipfi tribuendam effe. Verum enimvero omnia experimenta, curiofius capta, in eo confentiunt, quod Thea viridis, & præcipue illa, quæ subtiliffimum, atque maxime penetrabilem, fpargit odorem, multo majori gradu virtutem relaxantem, quam Thea Boheæ dicta, præftet. Id quod animum mihi addidit investigationes inceptas ulterius atque plenius profequendi.

2. Hoc fine libram dimidiam herbæ Theæ viridis optimæ notæ, & admodum fragrantis, cum aqua fimplici  
distillavi,



of a highly scented, and pellucid liquor,  
which exhibited no signs of astringency,  
nor

distillavi, atque aquæ insigniter odoratæ, pellucidæ, un-  
ciam unam, quæ nullum oleum in superficiem excutiebat,  
neque ulla virtutis adstrictivæ exhibuit indicia, elicui.

3. Eam partem liquoris, quæ finito stillicidio in vase  
distillatorio remansit, ad extracti consistentiam evaporavi,  
quod levem odorem, attamen saporem valde amarum ad-  
stringentemque habebat. Extracti acquisiti copia uncias  
quinque totidemque drachmas æquabat.

### EXPERIMENTUM III.

IN abdominis cavitatem, atque membranam cellulosam,  
ranæ injeci circiter tres drachmas aquæ stillatitiæ odoratæ.  
(No. 2.) Post viginti minuta alterum ranæ crus, seu pes  
posterior, multum adficiēbatur, dum parum mobilitatis,  
aut sensibilitatis, monstrabat, quæ adfectio per quatuor  
horas perseverabat, & rana in statu torpido insensibili uni-  
versali ultra novem horas manebat, donec gradatim ad  
pristinum vigorem redirect.

Simili ratione liquorem a destillatione Theæ viridis  
(No. 2.) superstitem, atque ulteriori evaporatione magis  
concentratum injeci, sed inde nullum effectum sensibilem  
inductum vidi.

### EXPERIMENTUM IV.

NERVIS Ischiaticis ranæ denudatis, atque cavitati ab-  
dominis, aquam stillatitiam fragrantem (No. 2. & Exp.  
III.) adplicui, intra dimidiam horam extremitates poste-  
riores,



nor had any oil floating on its surface, distilled from half a pound of fine hyson tea. In twenty minutes the hinder extremities of the frog were strongly affected, and continued so four hours, whilst the animal remained in a torpid, insensible state upwards of nine hours, and then recovered by degrees its former vigour. He made the same experiment with the  
*residuum,*

riores penitus paralytica insensilesque deveniebant, & post horæ circiter spatium rana vivere desit.

Liquorem a distillatione residuum (No. 2. & Exper. III.) eadem ratione alii ranæ admovi, sed nullos inde natos observare potui effectus sedantes, immo virtutem magis stimulantem, quam sedativam, præstare videbatur.

Extractum (No. 3.) in aqua solutum, & sub iisdem conditionibus, iisdem partibus admotum, nullum effectum sensibilem produxit.

4. Experimenta hæc enumerata nullis commentariis egent. Extra omnem dubitationis aleam ponere videntur, quod effectus Theæ sedativus & relaxans a principio odorato, volatili, aromatico, potius, quam ab aqua calida dependeat. (No. 1.) Non pauca utriusque sexus subiecta mihi innotuerunt, quæ maxima molestia & anxietate torquebantur, quotiescumque unum tantum poculum infusi Theæ potaverant, quæ tamen, consortio gratificandi ergo, aquam calidam loco, & more, infusionis Theæ, sine ullo effectui incommodante hauserunt.

*residuum*, left after distillation, which produced no sensible effect.

HE applied to the ischiadic nerves of a frog, when laid bare by dissection, and to the cavity of the *abdomen*, the same scented, distilled liquor mentioned above. In half an hour the hinder extremities became totally paralytic, and about an hour afterwards the frog died. The *residuum*, after distillation, was applied to another frog under the same circumstances, but seemed to produce rather an astringent, and stimulating, than narcotic effect. He prepared an extract from this *residuum*, which being dissolved in water, and used in a similar manner, had no visible operation.

THESE experiments demonstrate, that the pernicious effects of tea depend on its more volatile parts, which are dissipated in a great degree by long keeping, by hasty drying, or by reducing it to the form of an extract. I have seen and tasted  
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of such an extract, made in the East Indies, which though bitter and astringent, was by no means unpalatable. A preparation of this kind, dissolved in hot water, would be a good substitute for the leaves of the tea plant.

BUT however cogent the objections may be, against the general and too frequent use of tea, candour obliges me to acknowledge, that it is capable of being applied to very important, medicinal purposes. From its sedative power, and the weakness which it suddenly induces, it might be administered with advantage in ardent and inflammatory fevers, in order to abate the force, and lessen the inordinate action of the *vis vitæ*. In such cases it should be given either in substance, or in strong infusion; and besides allaying the troublesome sensations of heat and thirst, which are the constant concomitants of those distempers, it would probably serve as a good substitute for some of the usual evacuations. And thus  
instead

instead of producing watchfulness, which is a common effect ascribed to it in weak habits, it would in all likelihood prove the safest and most salutary opiate. After a full meal, when the stomach is oppressed, the head pained, and the pulse beats high, tea is a grateful diluent, and agreeable sedative. And as studious, sedentary men are particularly subject to indigestion and the head ach, it is on this account justly stiled “the poet’s friend.” Other uses to which tea is applicable might easily be pointed out; but I have already made too long a digression.

THE 29th. experiment affords a further proof, that the astringent parts of the *cortex* are as well extracted by maceration as by decoction. But I am inclined to think from this, and many other trials, that the astringent quality of this medicine is not so great as it is commonly reputed to be: and consequently the prejudice entertained against the use of it, in cases where powerful astring-



astringents are supposed to be contraindicated, is without sufficient foundation. Thus it hath been a commonly received rule not to exhibit the bark in intermittents, before the disease be in some measure spontaneously abated; and then to administer it only in the intervals of the fits. (*a*) But this extreme caution, as it took its rise at first from false theory, is found by later experience to be in most instances unnecessary; and the *cortex* is now frequently given with the utmost safety and success, after previous evacuations, not only at the commencement of the disorder, but even just before the accession of the cold fit. This was the common method of exhibiting the bark when it was first introduced into Europe. (*b*) But Sydenham informs us, that

(*a*) CURANDUM est ante omnia ne præmature nimis hic cortex ingeratur, ante scilicet quam morbus suo se marte aliquantisper protriverit.

Sydenham. Opera. p. 57.

(*b*) THO. BARTHOLIN. Hist. Anatom. Medic. Cent. 5. p. 108.



that not long after it came into disuse, for two reasons; “ *Primó quia paucis horis ante adventum paroxysmi, pro recepto id temporis more, exhibitus, ægro nonnunquam è medio tolleret. Funestior hic pulveris exitus, quamvis oppidó rarus, medicos tamen paulo cordatiores ab ejus usu meritó retraxit. Secundó quia æger ope pulveris, á paroxysmo aliás invasuro liberatus, quod plerumque eveniebat, tamen intra dies 14. recidivam ut plurimum pateretur, in morbo scilicet recenti, necdum temporis cursu suoque marte committigato.* (a) The last objection would have been obviated by a longer use of the bark; the first is totally without foundation. For the very few instances of mortality (Sydenham only enumerates two) which immediately succeeded the exhibition of the *cortex*, were not to be ascribed to the operation of the powder, but to the violence of the cold fit, which without doubt would have carried off the patients, had no medicine been

(a) Sydenhami Opera, p. 265.

been administered. For the natural tendency of the bark is to moderate, and not to increase the force of the paroxysms. And so far is it from producing obstructions, when given, with proper precautions, at the beginning of intermittents, that it effectually prevents them, by putting a speedy stop to the disease, the continuance of which in weak habits is the true cause of their formation. “ I am convinced, says Mr. Cleghorn in his excellent treatise on the diseases of Minorca, that the unhappy *metastases*, which some have observed to follow the use of the bark, are exceedingly rare, and ought rather to be ascribed to other causes than to this medicine. And I will venture to affirm, that more bad consequences ensue from giving it too late than too soon; prostration of strength, sudden death, or the most obstinate chronic diseases, being the usual effects of delay. Whereas the worst that commonly happens from the too early use of it, is, that it does not at once restrain

strain the paroxysms like a charm, without any sensible evacuation, as it frequently does, when given after the fever has arrived naturally to its height, and begins to decline of its own accord." (a) In another part of his work, the same ingenious and accurate writer observes, "that the great advantage which accrues from the early use of the bark in tertians is, that it invigorates the powers of the body, prevents or removes the dangerous symptoms, and brings on a crisis soon, and with little disturbance. Instead of suppressing any beneficial discharge, as some have asserted, we daily observe a laudable separation in the urine, warm, profuse, universal sweats, plentiful bilious stools, and sometimes the hæmorrhoids, and menses coming on after it has been used; though it effectually restrains the colliquative night sweats, to which persons weakened by tedious intermittents are incident." (b) Morton, who

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(a) *Dis. of Minorca*, p. 206.

(b) *Id.* p. 189. 190.

had great experience of the innocence and efficacy of the *cinchona*, frequently prescribed it without premising any evacuations; and he asserts, that after twenty five years practice, he never knew the least bad consequence ensue from its exhibition, nor had ever occasion to repent the use of it. Dr. Lind informs us, that for three years past, he has annually prescribed upwards of one hundred and forty pounds weight of bark, and never observed any bad symptoms which could with propriety be ascribed to its use, except in two instances; in one of which it was supposed, though perhaps without sufficient foundation, to have occasioned an obstruction of the *menfes*; in the other it produced a fit of suffocation in an asthmatic patient, probably owing to its being given in substance, and in too large a dose. (a) A celebrated professor at Vienna has related a number of curious cases, which fully evince the safety and efficacy

(a) *Vid.* Lind on the hot Climates. p. 294.



efficacy of the bark in semitertians, miliary, and malignant fevers. *Cortex peruvianus, vel declarante se malignitate, aliquamdiu post eruptionem exanthematum, vel cum ipsa exanthematum eruptione, vel etiam ante eruptionem eorum, vel ab ipso morbi principio, ilico summo cum effectu datus est.* (a) In the inoculated small-pox, instances of severe ague fits have been known to attack persons, between the insertion of the variolous matter, and the eruption of the pock, when the bark hath been given liberally and with success, the principal business in the meantime suffering no injury or interruption. (b) And in the confluent small-pox a very free use of it has not seemed, in a variety of cases to have abated the spitting. (c) The retrocession of the morbid acrimony in the measles, is pre-

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vented

(a) *Vid.* De Haen Rat. Medend. vol. 1. p. 166. 264. 265. Paris Edit.

(b) *Vid.* Dimsdale on Inoculation. p. 12. *vid.* also the Monthly Review for Sep. 1766. p. 189.

(c) Medical Transact. vol. 1. p. 469.



vented by nothing more powerfully than by the *cortex*, which obviates the secondary fever, allays the cough, and continues the efflorescence on the skin even to the twelfth day: whilst the disease runs through its accustomed stages with the utmost regularity, and creates much less disturbance and alarm than usual. (a) I had lately under my care a patient, who was seized with an intermittent, whilst he laboured under a severe *gonorrhæa*. The bark was given him in large quantity; and so far was it from suppressing the discharge, that it evidently increased it, and at the same time diminished its virulence. The late Dr. Whytt informs us, that he swallowed in sixteen days, near four ounces of it in substance, when he laboured under a catarrhus cough, without feeling any bad effects from its astringent quality. In a tertian, attended with a cough and spitting, after the use of vomits and some pectorals, he prescribed

(a) *Vid.* Dr. Cameron's Paper, Med. Museum. p. 281.

scribed the *cortex* in the usual quantity, without the breast being any way hurt by it. And he had repeated experience of its virtues in curing a hoarseness after the measles, when unattended with a fever or difficult respiration. In the whooping cough also, when given early, he found it one of the best remedies. (a) The bark has been successfully administered, in the quantity of a drachm, every three hours, to a woman two days after her delivery, without lessening the *lochia*; and it has been frequently given to others during their *catamenia*, without the least interruption of them. (b) These facts sufficiently evince the common apprehensions concerning the astringent quality of the *cinchona* to be groundless. And it may be hoped, that all such prejudices against the use of it will now vanish; as by its efficacy in the cure of scrophulous, glan-

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(a) Whytt on Nervous Disorders, p. 241.

(b) Medical Transact. vol. 1. p. 469.

dular tumours, it is proved to be even a powerful deobstruent.

THE property of striking a black colour with green vitriol hath been ascribed to all vegetable astringents without exception, and hath hitherto been regarded as an infallible test of their astringency. (a) But from the 29th. 30th. and 31st. experiments it is evident, that neither the one, nor the other are strictly and universally true. For gentian appears to be endued with no inconsiderable astringent power, and yet the infusion of it suffers not the least change from the addition of *sal martis*. On the contrary, the infusion of rue has no degree of astringency on the dead fibre, and yet it strikes a faint black with green vitriol.

THE

(a) THE power by which they produce this blackness, says a celebrated chemist, and their astringency, or that by which they contract an animal fibre, and by which they contribute to the tanning of leather, seem to depend upon one and the same principle, and to be proportional to one another.

Lewis Com. Ph. Tech. p. 345.

THE action of acids in neutralising vegetable bitters, as described in the last section, naturally led me to try their effects on the animal bitters. For this purpose I procured a quantity of fresh ox gall; but being prevented for several weeks, by various avocations, from pursuing my experiments, I found the gall at the end of that term extremely putrid. This accident pointed out to me a train of enquiries, somewhat different indeed from what I had at first proposed to myself, but which afterwards appeared to be much more interesting and important. I shall therefore make no apology for laying before the reader the result of them.

### EXPERIMENT XXXIII.

PUTRID ox gall, diluted with water, struck a green colour with syrup of violets, and sensibly effervesced with oil of vitriol, became turbid and of a light yellow colour. This experiment was repeated several times, and always with the



same success; so that I am pretty confident there must have been some error in that trial of Dr. Macbride's, from which he concludes, "that putrid ox gall shews no sign of alkali; it neither effervesce with acids, nor does it change the colour of the blue juices; neither does it throw down any precipitate from the solution of corrosive sublimate." (a) At first it occurred to me, that the mistake into which this very ingenious and accurate experimentalist hath fallen, might arise from his not diluting the gall before he added the acid; by which the latter would be so inviscated, as not to give sufficiently evident signs of effervescence. But afterwards the curious observations of M. Gaber of Turin, concerning putrefaction, suggested to me a still more probable source of fallacy to which Dr. Macbride was exposed. That learned Italian hath clearly proved, "that the marks of alcalescence in putrifying animal

(a) Macbride's Essays, p. 101.



mal substances, are greater or less, or none at all, according to the time the experiment is made after the putrefaction begins; that such substances, upon their first putrefaction, do not effervesce with acids; that afterwards they effervesce manifestly with them; but that at length they cease from doing it, though the putrefaction still continues." (a) Now it is not unlikely that Dr. Macbride's trial on the ox gall, was made, either before the volatile alkaline salt was formed, or after it was evaporated; as Sir John Pringle candidly acknowledges, happened in his experiments on putrid substances.

#### EXPERIMENT XXXIV.

To two drachms of putrid ox gall, diluted with half an ounce of water, were added twenty drops of *ol. vitriol.* A light yellow

(a) *Vid.* Miscellanea Phil. Mathem. Societat. Privat. Taurinensis: *vid.* also, Pringle on the Diseases of the Army, Append. p. 125.

yellow cloud instantly formed itself, and the mixture slightly effervesced and became turbid: But though the peculiar fetor of the gall was destroyed, yet it emitted a strong and disagreeable smell, nor was its bitter taste entirely corrected. Thirty drops rendered the mixture rather sharp to the taste; but still the bitterness was perceptible: Nor did forty drops entirely destroy it, although that quantity made the mixture very sour. After standing a while, it assumed a deep green colour, a sediment gradually formed itself, which in twenty four hours subsided to the bottom of the glass, and left the liquor above almost clear.

#### EXPERIMENT XXXV.

To the same quantity of putrid gall and water as in the former experiment, were added forty drops of white wine vinegar. The putrid fetor was entirely destroyed, and no other disagreeable smell was produced in its room. The mixture  
became

became turbid, but in a less degree than the former with the oil of vitriol; and the effervescence was likewise much more obscure. Sixty drops of vinegar seemed nearly to neutralise the gall. For though some small degree of bitterness remained, it was very trifling, and by no means unpalatable.

### EXPERIMENT XXXVI.

To a third glass of gall and water, mixed together in the above-mentioned proportions, were added forty drops of juice of lemons. The mixture became turbid, but the putrid smell was not perceptibly covered. A hundred and twenty drops neutralised the mixture, entirely correcting both the odour and taste.

I. FROM these experiments may be deduced, the great utility of acids in all diseases which either proceed from, or are accompanied by a redundance and depravation of the bile. And this seems  
to

to be the case with most autumnal fevers, and in general with the epidemics of all hot countries, especially where heat and moisture are conjoined. For the former promotes the generation, and the latter the putrefaction of the bile. I have been assured, says Dr. Bryan Robinson, by a very knowing butcher, that animals have least bile in January, and most in July. (a) And Hippocrates hath observed, *Æstate sanguis adhuc viget, sed et bilis exaltatur; per æstatem etiam ac autumnum bile corpus abundat; autumno autem atra-bilis plurima est et fortissima.* (b) Mr. Cleghorn, in his account of the diseases of Minorca, informs us, that he examined the bodies of near a hundred persons who died of tertian fevers, and that he constantly found the *vesica fellea*, and the stomach and intestines overflowing with bilious matter. (c) The testimony of Prosper Alpinus

(a) Robinson on the Operation of Medicines, p. 48.

(b) Hippocrates lib. de Nat. Hom. sect. 14.

(c) Dis. of Minorca, p. 165.



Alpinus likewise, strongly confirms the truth of this observation. He says, *Alexandriæ autumno grassantur febres pestilentes multæ lethales, quæ fere quamplurimos invadunt. His vero notis pleræque dignoscuntur: in principio enim vomitus multi, biliosi ac virulenti observantur, à quibus cibum assumptum continere nequeunt, assidueque corporis agitationibus, inquietudinibusque vexantur, stomachique angore anguntur. In plerisque etiam observantur multæ, symptomaticæ dejectiones, liquidæ, biliosæ, variæ, admodum ægré olentes sive fætentes.* (a) The yellow fever of the West Indies is always at the beginning attended with great sickness, violent retching, and a copious discharge of bile. The vomiting recurs at short intervals, often becomes almost incessant, and an incredible quantity of bile is sometimes thrown up in a few hours. (b)

## 2. THE

(a) Alpinus de Medicin. Ægypt. lib. 1. cap. 14. p. 51.

(b) Vid. Hillary's Observ. on the Dis. of Barbadoes: vid. also Bisset's Medical Essays and Observations.



2. THE difference between the action of mineral and vegetable acids on putrid gall, as evidenced in the preceding trials, is deserving of particular notice. From the ignorance of this distinction, or want of attention to it, I believe the elixir of vitriol is often exhibited, when vinegar, or the four juices of vegetables, would be much more serviceable. For though it is the common property of all acids to *correct* the putrid acrimony; yet the power of *sweetening* it, seems to be peculiar to those of the vegetable class. And as they are mildly aperient at the same time, they will not only neutralise the septic *colluvies*, which in some diseases lodges in the stomach and flexure of the *duodenum*, but will also gently tend to evacuate it: an advantage not to be expected from the mineral acids.

3. MR. BROWNE LANGRISH, in his Modern Theory and Practice of Physic, relates the case of a poor man, who after  
eating

eating heartily of stale mutton, which he bought on account of its cheapness, was affected with vomiting and purging to a strange degree, and in all respects seemed as if he had been poisoned. Vinegar, diluted with water, contributed more than any other medicine towards his cure.

4. A TABLE spoonful of the juice of lemons, unmixed with any thing, is said by an ingenious writer, (*a*) to have repeatedly proved a certain cure for a palpitation of the heart, after many of the medicines, called antihysteric, had been tried in vain. This effect he ascribes to an uncommon disposition in the nerves of the stomach. But I think it is not improbable that the complaint proceeded from bilious acrimony, which the vegetable acid corrected and neutralised. This conjecture is confirmed by a similar case which Dr. Bisset hath related, of a middle aged gentleman who had a palpitation

on

(*a*) Whytt on Nerv. Disorders, p. 372.

on of the heart, accompanied with some symptoms of the jaundice, and who was completely cured by drinking every evening weak rum punch, acidulated with the juice of Seville Oranges. (*a*)

5. I HAVE been lately informed by an ingenious practitioner, that he has seen four cases of a suppression of urine, supposed to arise from gravel in the kidneys, almost instantly removed by the juice of lemons. Not long after taking it the patient voided a quantity of fabulous matter. In one case, a very painful chordee accompanied the complaint, which immediately yielded to the same medicine. All the patients were of bilious habits, and it is probable, the lemon juice resolved the spasms of the urinary passages, by correcting some putrid acrimony in the stomach, or by producing a grateful sensation in that organ. Sydenham recommends the juice of lemons, joined with  
manna,

(*a*) Bisset's Medical Essays and Observ. p. 254.

manna, as a remedy for the gravel, and found in his own case that it rendered the purgative quicker in its action, and more agreeable to his stomach.

6. FROM the effect of acids on the gall, we may infer the reason why the immoderate use of them so much impairs digestion. The bile in its natural state is a saponaceous fluid, absolutely necessary to chylication; and whatever weakens its powers, must proportionably injure the due concoction and assimilation of our food. Hence the body is deprived of its proper nourishment and support, the blood becomes vapid and watery, and a fatal cachexy unavoidably ensues. This has been the melancholy lot of many unfortunate persons, who in order to reduce their excessive corpulency, have indulged themselves in the too liberal use of vinegar.

7. IT is not improbable that the acidities,  
M



ties, to which infants are peculiarly subject, arise as much from the weakness of their biliary secretions, as from the acescency of their food. The liver of a child is extremely lax in its texture, and with respect to his bulk, is much larger than the liver of an adult : Hence the secretions of the one, will be proportionably greater than the secretions of the other. But though the bile flows copiously, yet the powers of nature in the state of infancy are too feeble for its due preparation ; and it is a mere watery, inert fluid, unfit for neutralising those acidities, which in the more advanced stages of life, it is one part of its office to correct. And this, I apprehend, is a principal cause of their redundancy in the *primæ viæ* of children.

THE frequent opportunities which the preceding course of experiments afforded me, of observing the effects arising from the combination of green vitriol and astringents,



tringents, naturally led me to examine into the principles of INK. And as the subject is not only curious in itself, but also interesting and important, from its relation to the arts of dying and staining black, I was induced to institute a new set of trials, in order to the more clear and accurate investigation of it. That a solution of vitriol strikes a deep black with vegetable astringents, is a fact universally known; but Dr. Lewis is almost the only chemist who hath attempted to explain it. He is of opinion that the colouring matter of ink is iron, extricated from its acid in a highly attenuated or divided state, and combined with a peculiar species of matter contained in astringent vegetables. Acids, he says, destroy its blackness by redissolving the ferrugineous particles; and alkalis by uniting with the astringent matter, and precipitating the iron nearly in the same

ochery state, as they do from the simple acid solutions of the metal. (a)

BUT from the following experiments I think it will fully appear, that this very ingenious and useful chemist is mistaken; and that the colouring matter of ink is iron, not extricated from, but in combination with an acid.

### EXPERIMENT XXXVII.

To half an ounce of the decoction of galls, was added one grain of *sal martis*: An inky blackness succeeded. Sixty drops of *sp. c. c. vol.* discharged the black, and rendered the liquor thick and brown coloured. A hundred and twenty drops of oil of vitriol restored the blackness; two hundred again discharged it, and gave the ink a yellow cast, inclining to green.  
This

(a) Lewis Comm. Ph. Tech. p. 348.

This experiment is illustrated by the following one.

### EXPERIMENT XXXVIII.

ONE grain of green vitriol was dissolved in half an ounce of spring water: forty drops of *sp. c. c. vol.* were added; a greenish yellow sediment formed itself, and presently subsided to the bottom of the glass, with little white flakes, which I at first judged to be calcareous earth, separated from the spring water by means of the volatile alkali. But the *sp. c. c. vol.* mixed with the same water, produced no precipitation. Oil of vitriol was then dropped in, to the point of saturation. When the effervescence ceased, the whole sediment was redissolved, and the mixture became quite clear.

### EXPERIMENT XXXIX.

A PIECE of polished iron was immersed

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in

in a cold infusion of the bark, made with distilled water. In three hours the liquor was just perceptibly tinged with black. The piece of iron was then taken out, wiped clean, and again immersed in another infusion of the *cortex*, of equal strength with the former, made with common spring water. In less than two hours, the infusion assumed a deep purple colour, and the fluid in contact with the iron was of an inky blackness.

THIS experiment clearly proves, that an acid is necessary to the formation of ink. Spring water is generally impregnated with some of the mineral acids, in combination either with certain metallic substances, the fossil alkali, or calcareous earth. The water employed in this trial, contained a considerable portion of selenitic salt; and hence it was capable of dissolving the iron which was immersed in it, and of forming with it a perfect *sal martis*. This sufficiently accounts for the

the deep purple hue which the infusion assumed. The distilled water was either not sufficiently pure, for I did not particularly examine it, or the *cortex*, which like all other vegetable substances, is of an acescent nature, communicated to it a slight degree of acidity, by which the iron was corroded, and a faint and scarcely perceptible blackness produced.

## EXPERIMENT XL.

THREE or four drachms of *sal martis* were dissolved in half a pint of boiling water. After standing a few days, that the ochre might precipitate, the solution was passed through brown paper. The filtered liquor was perfectly clear, discovered no marks of acidity to the taste, and struck a deep black with the infusion of galls. In four or five days it let fall a very fine, light, yellow sediment, was again passed through the filter, and struck as before a deep black with the infusion



of galls. I did not prosecute this experiment any further; being satisfied from the trial I had made, that the acid and the iron, the component parts of green vitriol, are not so easily separated from each other as is commonly supposed. And it is probable that the acid, after the precipitation of the ochre, still retains as much ferrugineous matter as is sufficient to saturate it, when so much diluted with water.

#### EXPERIMENT XLI.

FROM a large copperas work established near Wigan, I procured a quantity of the yellow ochre precipitated from green vitriol; and of a chocolate coloured pigment, made by exposing the ochre to such a degree of heat, as is sufficient to separate the acid, and give it what the painters term a BODY. Neither the ochre, nor the pigment were attracted by the magnet, a proof that they were both

both in a state of calcination. Three grains of the ochre, and the same quantity of the chocolate coloured pigment were added to two glasses, each containing half an ounce of a decoction of the bark. The pigment communicated to the decoction its own peculiar colour; but the yellow ochre struck with it a deep purplish black. Twenty drops of *sp. c. c. vol.* made no change in the decoction with the pigment; but the other instantly lost its black, and assumed a chocolate colour, exactly resembling that of the pigment.

## EXPERIMENT XLII.

THE result of the last experiment led me to imagine, that an alkali dropped upon the ochre would render it brown by abstracting its acid; and on the contrary, that oil of vitriol added to the chocolate pigment would restore its yellow colour, and give it the property of striking a  
black

black with vegetable astringents. I therefore diffused four grains of the ochre, and the same quantity of the pigment, in two glasses of water. To one I added twenty drops of *sp. c. c. vol.* to the other the same quantity of *ol. vitriol.* The hartshorn immediately precipitated the ochre in fine light flakes, but did not either effervesce with it or alter its colour: The acid had no sensible effect on the pigment. Thus was I doubly disappointed in the issue of this experiment.

### EXPERIMENT XLIII.

A FEW drachms of the yellow ochre were well mixed with four ounces of spring water. As soon as the ochre subsided, the liquor above was carefully poured off, and passed through common filtering paper doubled. It had acquired a deep orange colour, was perfectly transparent, had an aluminous taste, and was remarkably styptic and astringent in the mouth.

mouth. A drachm of it struck a deep green, inclining to black, with half an ounce of the bark decoction. I instilled twenty drops of *sp. c. c. vol.* into a table spoonful of it: No effervescence ensued, but a very copious, flaky, and yellow sediment was instantly produced. I kept the remainder of the orange coloured liquor, in an open glass vessel for several weeks, without observing the least ochery precipitation, or any diminution of its transparency. And this I apprehend is a proof, that a firm and lasting combination takes place, between certain proportions of the component parts of green vitriol.

THE same ochre was macerated in fresh parcels of water, till the filtered liquor had neither taste, colour, nor the property of giving the least black tinge to an infusion of galls. The ochre was then dried by a very gentle heat, and two scruples of it were added to half an ounce  
of

of the same decoction of the bark, which was used in the former experiments ; but no change of colour ensued, only the decoction assumed a lighter yellow, whilst the particles of the ochre floated in it.

#### EXPERIMENT XLIV.

SPIRIT of hartshorn, dropped into a solution of green vitriol, occasioned a copious precipitation, but no effervescence. It cannot be alledged therefore, that the yellow ochre contains no acid, because it doth not raise a sensible ebullition with the volatile alkali.

THUS it appears that whatever deprives green vitriol of its acid, whether it be heat, the addition of an alkali, or repeated affusions of water, destroys its power of striking a black colour with vegetable astringents. May we not then justly conclude, that an acid is essentially necessary to this property, which it is more than



than probable depends upon the composition of the copperas as a mixt; and not upon either of its constituent parts separately taken. Ink therefore is a combination of vitriolic acid, iron, and a certain proportion of vegetable astringent matter. (*a*) But as these principles bear but a weak relation to each other, their band of union is easily dissolved, and it has long been a desideratum in chemistry, to render it more fixed and permanent. Acids by attracting the astringent matter, with which it is evident from many of the foregoing experiments they have a strong

(*a*) AN ingenious friend of mine (Dr. Falconer of Bath) is of opinion that a double elective attraction takes place in the production of Ink. The acid forsakes the iron and combines with the vegetable astringent, separating from it the phlogiston, which unites with the iron. In support of this hypothesis he observes, 1. that mineral astringents, such as earth of alum, &c. precipitate iron, as well as those of the vegetable class; but affording no *phlogiston*, the precipitate is in an ochrous state. 2. That the black sediment of ink is easily soluble in acids, whereas the *calces* precipitated by alkalis are of very difficult solution, owing to the almost entire loss of their *phlogiston*. For a perfect calx is found to be absolutely insoluble.

strong affinity, discharge the black colour of ink. Alkalis on the contrary decompose it, by abstracting the acid from the vitriol, and precipitating the iron. If the blackness hath been destroyed by an acid, the addition of an alkali in due proportion will restore it, and *vice versa*. The reason why they thus counteract each others effects, is too obvious to require an explanation.

A RECAPITULATION OF THE PRINCIPAL  
FACTS ASCERTAINED BY THE PRE-  
CEDING EXPERIMENTS.

1. **T**HE PERUVIAN BARK, and many other vegetable bitters and astringents, yield their virtues as perfectly to cold as to boiling water.

2. As much of the Refin of the Bark is dissolved by cold maceration as by coction.

3. TRITURATION promotes and increases the solution of the Bark in water.

4. A STRONG infusion of the Bark may, by means of triture, be prepared with great expedition.

5. QUICK

5. QUICK LIME neither quickens, nor increases the solution of the Bark in water.

6. THE BARK will not yield all its virtues either to cold water, boiling water, or rectified spirit of wine, nor probably to any other *menstruum* singly employed. After thirty cold macerations, and twenty five coctions in different parcels of water, each *residuum*, though perfectly insipid, yielded a bitter and astringent tincture, when digested in rectified spirit of wine. On the contrary after repeated digestions in rectified spirit of wine, when that *menstruum* acquired neither taste nor colour from the bark, cold water extracted from it a manifest degree of astringency.

7. COLD WATER is a more powerful solvent of the bark, than rectified spirit of wine. But brandy is a stronger *menstruum*





astringent power on the dead fibre; the mineral acids increase it.

II. ASTRINGENCY and BITTERNESS are distinct properties, and are united together in very different proportions in different vegetables.

12. NEITHER the taste, nor the power of striking a black colour with chalybeates, nor yet the property of hardening animal fibres, whether singly or collectively taken, are certain criteria of the astringent power of a medicine on the living body.

13. THE power of striking a black colour with green vitriol is not always a test of astringency on the dead fibre; nor is it common to all vegetable astringents. Rue yields a faint black, on the addition of *sal martis* to an infusion of it, and yet is not astringent: Gentian on the contrary,

trary, strikes no black, although it is a pretty strong astringent.

14. PUTRID GALL is neutralised by all acids. But those of the native vegetable class alone, entirely sweeten it.

15. WHATEVER deprives green vitriol of its acid, whether it be heat, the addition of an alkali, or repeated affusions of water, destroys its power of striking a black colour with vegetable astringents.

16. AN ACID, contrary to the opinion of Dr. Lewis, appears to be essentially necessary to the above-mentioned property of green vitriol.

17. INK, seems to be a combination of vitriolic acid, iron, and a certain proportion of vegetable astringent matter.

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E S S A Y IV.

O N

T H E U S E S

A N D

O P E R A T I O N

O F

B L I S T E R S.

VI Y A 2 2 2 2  
*Certé hinc lucis aliquid erui poterit, quâ  
id tandem, in quo medicorum diligentiam  
desidero, effici queat, ut accurata de ve-  
sicantium in diuturnis affectibus præcepta  
tradantur, quæ et perspicuitatem habeant,  
et quasdam errare in medendo non patien-  
tes vias.*

FRIEND.



## E S S A Y    I V .

### ON THE USES, AND OPERATION OF BLISTERS.

**T**HOUGH the action of cantharides as vesicatories was not unknown to the ancients, their application did not prevail much in practice, till the beginning of the last century. And as nothing hath tended more to enlarge the boundaries of science, than the contentions of the learned; we owe perhaps, in a good measure, our present more accurate acquaintance with the virtues and operation of blisters, to a dispute amongst the Italian physicians, relating to their use in

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a plague,

a plague, which prevailed about the years 1575 and 1590. But although blisters are now almost universally employed, and experience hath ascertained their utility in various disorders; the theory of their action, as well as the mode of their operation, is yet undetermined, and remains a subject of litigation. Hence arises that diversity of opinions concerning the diseases in which they are indicated, the time of their application, and the parts to which they ought to be applied. Nor can we ever hope for uniformity in this particular amongst physicians, either with respect to their opinions or their practice, till a juster idea be formed of their mode of action; deduced from experience, and an attentive observation of their effects on the human body. When this is accomplished, a system of rules may be laid down for their right and advantageous application.

MEDICINES are generally divided into  
such

such as act, 1. on the solids, 2. on the fluids: and Blisters may be considered as belonging to each of these classes; though their relation is chiefly to the former. But here a question occurs, whether vesicatories produce their effects by their external action on the body, or by the absorption of their stimulating particles into the system? Baglivi furnishes us with two curious, though cruel experiments, of the injection of two ounces of the tincture of cantharides, into the jugular veins of a dog and a whelp. Great anxiety, violent pain, insatiable thirst, convulsions, and death, were the consequences in each instance. But no certain or just inferences can be drawn from these experiments; because medicines are not administered by injection into the blood vessels; and substances much less acrid in their nature than cantharides, if conveyed directly and undiluted into the course of circulation, will be found to produce effects similar, or at least

least equally deleterious. (*a*) When taken by the mouth in an over-dose, the most dreadful symptoms succeed; an exulceration of the bladder and *urethra*, inflammation of the bowels, violent pains in the *hypogastrium*, extreme thirst, a high fever attended with delirium, and at last death closes the melancholy scene. The like effects it is said, though in a less degree, have been observed to arise from the application of blisters. And it is upon these active powers of cantharides when absorbed into the system, properly modified and seasonably applied, that the effects of vesicatories are supposed by several learned writers chiefly to depend. (*b*) The quicker contractions of the heart and arteries, in consequence of their application in certain disorders, they ascribe,

(*a*) New milk injected into the veins of a dog proves a mortal poison.

Young on Opium, p. 6.

(*b*) Baglivi, Friend, Glafs, Huxham, &c. &c.

ascribe, not to a sympathy with the skin, but to a stimulus circulated with the fluids, and acting immediately on the vessels themselves. And as Baglivi hath asserted that cantharides have the property of colliquating the blood, when mixed with it out of the body, they apprehend that the good effects of blisters in fevers, attended with a glutinosity and lentor in the fluids, arise principally, if not entirely, from their attenuating and dissolving powers. But this theory of the operation of vesicatories is liable, I think, to many objections.

1. IF their action depend upon the stimulus of the absorbed cantharides, they should in all cases quicken the contractions of the vascular system. But this is contradicted by experience; for in pleurifies, peripneumonies, and other inflammatory diseases, where the heart and arteries are already acting very strongly,



ly, they abate the inflammation and lower the pulse. (*a*)

2. THE small portion of cantharides, which may be carried into the course of circulation by the lymphatics of the skin, cannot I apprehend be adequate to the effects ascribed to it, whether we consider the large mass of fluids with which it is mixed and diluted, or the coats of the vessels lined with a mucus, which must defend them from any slight degree of acrimony. It may indeed be said, that the usual effects of a blister on the urinary passages shew, that the particles of cantharides are absorbed in sufficient quantity, to irritate and vellicate the internal parts of the body. But allowing this objection its full force, by granting what is disputed by some, that the strangury arises from the immediate action of the flies on the urinary passages, this

(*a*) Whytt's Experiments, Ph. Transact. Vol. 50, p. 2.

this by no means proves their stimulating power, when circulating with the general mass of fluids. All extraneous bodies introduced into the blood, and not capable of being animalized, pass off by one or other of the excretories. If they are of such a nature as to be volatilized by the common heat of the body, they are eliminated by the lungs, and pores of the skin, along with the matter of insensible perspiration. Garlick, onions, asafætida, sulphur, and most of the essential oils, afford examples of this kind. But if the extraneous matter be less volatile, if it be incapable of chemical mixture with the blood, or if it unite only with the serum, it will be carried to the kidneys, and pass off by urine. Of this nature are cantharides; (*a*) and when their acrid particles are, in continual succession, applied to

(*a*) BAGLIVY on mixing cantharides with the serum of the blood, found the powder precipitated soon after to the bottom of the vessel, without having produced any change in the colour of that fluid.

to the highly sensible and nervous membrane, which lines the urinary ducts, can we wonder at the strangury, and other painful effects which they produce. (*a*)

3. THE same objection may be made to the attenuating power of cantharides, as introduced into the blood by means of blisters. Is it at all probable, that a few grains of cantharides can act so powerfully, as to dissolve a general lentor and viscosity of the whole mass of fluids? Mercury it is true, in a very small quantity, will excite a salivation: But it does not produce this effect, by breaking down the *crasis* of the blood, though the

(*a*) It is not improbable, that the nerves of the urinary passages are disposed to be more irritated by the acrimony of the flies, than those which are distributed to the other organs of the body. For Dr. Whytt hath ingeniously proved, that the different operation of medicines, depends very much on the particular nature, and diversified sensibility, of the nerves of different parts of the body; by which they are differently affected by the same kind of stimulating substances.

*Vid.* Essay on Nerv. Dis.

the continued use of it may have that tendency, but merely, as I conceive, by its partial stimulus on the salivary glands. An eminent practitioner informed me, that he had more than once ordered blood to be taken from patients under salivation, which he found not in a dissolved, but even in a buffy state. But it may be presumed, I think, that cantharides are not possessed, in any considerable degree, of a colliquative power; for they have no chemical relation to the animal fluids, and Sir John Pringle hath proved, that they are by no means septic. (*a*) As this, however, is a point of some importance, the two following experiments were repeated after Baglivi, in order to determine it.

### EXPERIMENT I.

FOUR ounces of blood, just drawn  
from

(*a*) Append to Dis. Army, Exp. 22.



from the arm, were divided into two equal portions; to one was added ten grains of *pulv. cantharid.* the other was kept as a standard. The portion with cantharides coagulated at the same time with the standard, and neither assumed a sublivid, nor an ash colour. Its surface was covered with a thin pellicle, but without the vesicles Baglivi describes. After standing a few hours, the crassamentum in part dissolved, as appeared from the colour of the serum, which was tinged with red; owing perhaps to a slight degree of agitation, which was used to mix the cantharides with the blood when fresh drawn.

THE portion without the cantharides separated into a clear, pale coloured serum, and a tough, ash coloured crassamentum; the surface of which contracted into the compass of a shilling, and retained that form till the putrefaction begun; which happened sooner in  
the



the standard, than in the other portion of blood.

## EXPERIMENT II.

TEN grains of *pulv. cantharid.* added to two ounces of serum, tinged by the crassamentum of a light, florid, crimson colour, rendered it more liquid, and changed it to a dull red. Contrary to the assertion of Baglivi, it coagulated with great ease, and with less heat than an equal portion of the same serum without cantharides.

5. THE chief symptoms induced by blisters, may be rationally accounted for, without having recourse to the absorption of the acrid particles, of which they are composed. These symptoms are a quick pulse, dryness of the tongue, thirst, strangury, &c. They quicken the pulse in the low state of fevers, by their stimulus on the skin, with which the whole

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vascular system sympathises. They occasion thirst, dryness of the tongue, and an increase of fever, in the same way, viz. by their external irritation. But these effects ought to be ascribed to the improper and unseasonable use of blisters. When the inflammatory *diathesis* prevails universally, and strongly, without any partial obstruction, every stimulus must aggravate the symptoms; and blisters raised on the skin, by a cataplasm of mustard, or by the actual or potential cautery, where the irritation is confessedly external, would operate in the same manner as an epispastic of cantharides. But in cases where vesicatories are indicated, I have never found, on the strictest examination, the least increase of thirst, or dryness of the mouth, in consequence of their application. (a) The strangury

(a) THE three histories which Baglivi relates of the effects of epispastics, carry very little authority with them; because the blisters were either ill timed, or laid on in too great

strangury has by some been supposed to arise, not from an absorption of cantharides, but from a sympathy between the skin and the urinary passages. And it is urged, that a warm fomentation of milk

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great numbers. The first case is that of a young man, of a bilious temperament, who after being heated, suddenly exposed himself to the cold wind. He was seized with an *angina*, which terminated in a violent pleurisy, attended with the strongest symptoms of inflammation. Six vesicatories were applied at once, to different parts of his body; the consequence of which was, a suppression of the *sputum*, tremors, convulsions, delirium, and death. The second history is that of a cook, who was attacked with a convulsion of the lower jaw, which was soon after succeeded by spasmodic contractions of the abdominal muscles. The *pulvis cornachini* was prescribed, and the next day four blisters were applied. Vomiting, convulsive motions, and an oppressed breathing ensued. On the fourth day he died. This case was probably a locked jaw; a disease too frequently fatal. The third history is that of a young and slender woman, eight months advanced in pregnancy, who after suffering much pain was at length delivered. The pain however still continued, accompanied with an uncommon tension of the belly. Four blisters were applied at one and the same time, as in the former instances. The *lochia* were immediately suppressed, convulsions

and water applied to a blistered part, very quickly relieves this complaint, by removing or diminishing the irritation on the surface of the body. But I confess, the probability lies on the other side of the question; and several reasons incline me to think, that the strangury is produced alone by the absorption, and internal stimulus of the flies.

1. NEITHER mustard, the actual or potential cautery, nor any other vesicating stimulus but cantharides, excite this complaint. And is it not strange, that the

vulsions came on, and at last the poor patient fell a victim to death.

Baglivius de Vesicant. p. 70.

FROM the application of so many blisters, it is not to be wondered at, that the thirst, quickness of the pulse, and other symptoms of acute diseases were, according to the experience of Baglivy, greatly aggravated. Besides, it is more than probable, that vesicatories are attended with greater inconveniences in warm, than in cold climates, because the inhabitants of the former are generally of more irritable constitutions, and of more adust and bilious temperaments, than those of the latter.



the urinary passages should have such a universal sympathy with all the different parts of the body to which cantharides are applied, whilst no such consent takes place, when any other vesicatory is made use of?

2. DRINKING plentifully prevents the strangury; and surely it can produce this effect in no other way, than by diluting in the kidneys and bladder, the acrimonious particles of the flies.

3. A BLISTER laid upon the head immediately after shaving, is almost always succeeded by the strangury; whereas no such effect takes place, if the application be delayed twenty four hours. How are we to account for this fact, unless by supposing, that the subtiler parts of the cantharides enter more readily, and in greater quantity into the blood, after the scarf skin hath been removed by the razor? The effect of a



warm fomentation, in alleviating the troublesome symptoms of this complaint, arises partly, perhaps, from its sedative operation on the whole system, but chiefly, I imagine, from its washing off all those acrid particles adhering to the skin, which would otherwise enter into the blood, and increase, or at least continue the irritation in the urinary passages.

BUT although it be acknowledged, that the strangury is occasioned by the stimulus of the cantharides, acting internally, yet the explanation given above of this effect, removes, I think, every objection to what has been advanced. I shall proceed therefore to consider the operation of blisters, according to the division already laid down.

THE diseases of the SOLIDA VIVA, in which they are indicated, are very numerous;



numerous; but taking a more general view of them, they may perhaps be reduced to three kinds.

1. WHERE THE ACTION OF THE MOVING FIBRES IS EITHER PARTIALLY, OR UNIVERSALLY TOO WEAK.

2. WHERE IT IS IRREGULAR.

3. WHERE IT IS PARTIALLY TOO STRONG.

IN the first case vesicatories are indicated, as a stimulus to the languid solids, to rouse them to more vigorous contractions, to support the *vis vitæ*, and to promote the salutary secretions. They tend to quicken the circulation, to raise the pulse, and to animate the whole system. Hence we may deduce their use and operation,

1. IN LOW NERVOUS FEVERS; when

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the spirits sink, when the contractions of the heart grow languid, and the unhappy patient struggles under anxiety, restlessness, delirium, difficulty of breathing, and a load and oppression about the *præcordia*. These symptoms arise from debility, and denote a kind of nervous orgasm, or spasm on the vitals, which requires cordial medicines, aided by the application of blisters. (a) An eminent practitioner hath indeed observed, that in these fevers, epispastics sometimes aggravate all the symptoms, and by their irritation occasion a small and contracted pulse. But this he ascribes to a mistake, either in the time, or place of their application. On the first signs of a delirium, when the urine turns pale, when the patient sighs, is anxious, and becomes dull of hearing, or when his eyes sparkle and look staring, &c. he advises to cover the whole head with a blister.

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(a) *Vid.* Huxham on Fevers, p. 82.

The epispastic will thus be applied as near as possible to the part affected; and as the head is less sensible to the stimulus of cantharides, than any other part of the body, all the bad effects arising from too great irritation will be prevented. (*a*) Baglivi long ago remarked, that blisters sometimes excite a small and contracted pulse; and I apprehend in the class of diseases now under consideration, their utility must always be attended with a peculiar degree of uncertainty. This depends on the nature of these fevers, and the concomitant state of the nerves. Whenever they are accompanied with little pain, but with a high degree of irritability, which is not unfrequently the case, blisters, I think, will be found to be prejudicial, by increasing the spasm, and throwing the system into confusion. But if the body, however languid and enfeebled, has been accustomed through  
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(*a*) *Vid.* Med. Essays of Edinburgh, Vol. 4. Art. 23.



the course of the disease, to the stimulus of pain, or if the nerves be not affected with an excess of sympathetic sensibility, epispastics may be applied with safety and advantage.

2. IN the advanced state of INFLAMMATORY FEVERS, when the patient becomes languid, or perhaps comatose, blisters are highly serviceable. And they are found to be very efficacious in removing those obstinate and oppressive head-achs, which have resisted every previous evacuation, and which often continue to the last period of the distemper. (*a*) The same observation holds true in every other species of fever, where such a train of symptoms occur as have been already described.

EVEN in malignant PETECHIAL FEVERS, notwithstanding the great dissolution

(*a*) *Vid.* Pringle's *Dis. of the Army*, p. 134.



lution of the blood, and the supposed tendency of cantharides to increase that dissolution, some of the most eminent practitioners have been bold enough to recommend blisters. Thus Riverius says, *Ubi maxima est malignitas, unicum vesicatorium non sufficit, sed plura admovenda sunt; soleo ego in magna morbi sævitia, quinque locis admovere, cervici nimirum, utrique brachio, parti interiori inter cubitum et humerum, et utrique femori, parti etiam inferiori inter inguina et genua, cum felici successu.* (a) Etmuller, treating of the same fevers asserts, *Si ulla est febris in qua vesicatoria conveniunt, est imprimis petechialis.* (b) And in the malignant, ulcerous sore throat, it must be acknowledged that they are productive of the best effects. But with deference to these great authorities, I think blisters should be applied with the utmost caution, in  
all

(a) Riverii Opera, p. 541.

(b) Etmuller. Op. p. 365.

all cases, attended with an highly putrid, and dissolved state of the fluids: For under such circumstances, they often exhaust the strength of the patient, by exciting an immoderate discharge of bloody serum; and they sometimes occasion a sudden, and fatal mortification.

3. IN the SMALL POX; when the patient is of a lax and weak habit, when the pulse is low, feeble, and depressed, and the fever insufficient for the expulsion and suppuration of the pustules, epispastics are certainly indicated. (*a*) When the pocks are of the bloody kind, and attended with delirium, Dr. Mead assures us, that blisters may be used with equal safety and advantage. And in this distemper, whenever the maturation of the pustules does not regularly succeed their eruption, and when anxiety, inquietude, difficulty of breathing,

(*a*) Hillary on the Small pox, p. 94. 95.

breathing, and delirium come on, the fever should be quickened by warm cordial medicines, and especially by the application of blisters. (a) This is confirmed by the testimony of Dr. Tissot, in a late publication, who after pointing out the analogy between the action of opium and cantharides in the small-pox, says, *Unicum est symptoma in quo dum hæc pulchra operantur à narcoticis caveo; ubi nimirum relicta cute, ad pulmonem acre devolvit viru, cum frequentissimo celerrimo, debiliq̃ue pulsu, cutis siccitate, orthopnœa, anxietate, delirio. Gravis est sanè casus, et è pessimis in medicina pariolosa, quem feliciter aliquoties, citò accersitus, curavi, larga et accerima vesicatoria suris applicando, largissimos et calidos haustus decocti hordei, et sambuci melliti prescribendo, cum minimis dosibus sulphuris aurati antimonii. Quatuor vel quinque lapsis horis, remittit frequentia pulsus, recedit*

(a) Mead, Sydenham, Morton.

*recedit anxietas, madet cutis, increſcunt vires. Omnino liberato peſtore, et demiffa febre, juvari poteſt natura leni narcotico. Diu fluere crura juvat.* (a) It is always accounted a bad ſymptom, when the ſwelling of the hands does not follow the tumour of the face, and the ſwelling of the feet that of the hands; and if the patient be threatened with this alarming circumſtance, epifpaſtics ſhould be applied to the wrifts and ancles, a little before the inflammation of thoſe parts may be expected to begin. For they will not only tend to draw the humours thither, but will give them alſo a ſalutary vent. (b) When the fauces are covered with puſtules, and both deglutition and reſpiration are impeded by the ſwelling of the throat, bliſters applied to the neck are highly ſerviceable, as I have frequently

(a) Tiffot. de Variolis, &c. *vid.* Sandifort. Theſaur. Vol. 2. p. 11.

(b) Huxham, p. 155.



frequently experienced. Dr. Tissot relates the history of a patient, under these circumstances, who was suddenly relieved by the application of sinapisms to the feet. *Vidi hoc anno collum horride turgidum, educ̃ta è lecto ægra, et sinapismis plantis pedum applicatis, intra viginti minuta, dimidiam diametri partem amisisse. Horrendos verum est pedum patiebatur dolores, quos per biborium tolerare suasi; tunc tumentibus admodum cruribus, sinapi removi; omnia pacabantur.* (a) In this instance, it is probable, that blisters would have been no less efficacious than the sinapisms; and they would have been more eligible, because productive of a less degree of pain and inflammation.

4. IN the APOPLEXY, whether arising from over distended vessels, injuring the brain by pressure, from the effusion of blood within the *cranium*, or from a pituitous

(a) Sandifort's Thesaurus, Vol. 2. p. 16.



tuitous collection there; after attempting to relieve the head by bleeding, cupping the *occiput*, with deep scarifications, and using such other evacuations, as the state of the patient may require, blisters may be applied, both to the head and extremities, with great advantage. By increasing the circulation of the blood externally, and by producing a considerable discharge of serum, they will unload the vessels of the brain; whilst by their stimulus, they rouse the torpid system of nerves, excite the heart and arteries to quicker and more vigorous contractions, and thus powerfully contribute, to restore the equilibrium between the *vis motrix*, and *moles movenda*.

5. IN the PALSY. When this disease invades the whole body, blisters are useful by their general stimulus. But they are most efficacious when the paralytic affection is not universal, but confined to some particular member or organ. Thus  
in

in palsies of the upper extremities, vesicatories applied to the *vertebræ* of the neck, and going obliquely to the shoulder, are remarkably useful. And when the disease attacks the lower extremities, they are equally efficacious, when laid upon the region of the *os sacrum*. In both cases, experience demonstrates that blisters thus applied are much more efficacious, than when laid upon the extremities themselves. As most of the nerves which go to the bladder, pass through the *foramina* of the *os sacrum*, vesicatories have been very successfully applied to that region, for the cure of an incontinence of urine. And it is probable, that they would be much more certain and powerful in their operation, if a proper attention was paid, in their external application, to the origin and course of the nerves. (a)

6. IN the GUTTA SERENA, when it  
P proceeds

(a) *Vid.* Lond. Medical Observ. Vol. 2. p. 318.

proceeds from a paralytic affection of the retina, blisters applied to the forepart of the head, so as to cover the nerves which issue through the *supra* orbital *foramina*, and spread themselves on the forehead, are highly serviceable, as I have more than once experienced.

7. IN the TYMPANITES, Celsus advises to make ulcers in several parts of the belly, and to keep them running. But we are furnished by means of epispastics, with a much more effectual, as well as more humane remedy. Dr. Mead recommends their application in this disorder; and it is probable they may do service, both as stimulants and antispasmodics, except where the case is complicated with a mortification of the bowels.

8. IN the RICKETS, Boerhaave recommends blisters, to stimulate the languid vessels, and resolve the mucous concretions.

9. IN

9. IN SCHIRROUS TUMOURS of the conglobate glands of the neck, blisters applied to the head, or behind the ears, have a good effect. The finer parts of the cantharides, being absorbed by the lymphatics, are carried immediately to the obstructed glands, and by their stimulus tend to disperse those indolent swellings. A young lady who had a hard, glandular tumour in her neck, which succeeded the small-pox, and had resisted very powerful applications, was lately cured of it by the application of a blister behind her ear, which I directed on account of an inflammation in one of her eyes. If the tumour be seated in the inguinal glands, vesicatories should be applied to the thighs. In such cases I have laid blisters over the glands themselves, but without any beneficial effect.

10. IN those schirrous, or œdematous tumours of the joints, usually called WHITE SWELLINGS, which after a tedious and ill conditioned suppuration,



corrupt the *synovia*, shorten the tendons, make the bones carious, and destroy the articulation, blisters applied to the part affected, have been sometimes highly serviceable. (*a*) But their operation should be assisted by the internal use of the Peruvian bark, calomel, or other alterative and deobstruent medicines. (*b*)

OTHER diseases, arising from the too weak action of the solids, might be enumerated; but sufficient has been said to prove the efficacy and utility of blisters in such cases.

2. WHERE THE ACTION OF THE MOVING FIBRES IS IRREGULAR, vesicatories are indicated, both as stimulants and antispasmodics.

#### CONVULSIVE

(*a*) *Vid.* Medical Transactions, Vol. 1. p. 104.

(*b*) THE Abbe Chappe mentions an epidemic disease in Russia, probably a species of the bronchocele, which the natives cure by the application of tobacco and sal ammoniac well masticated. The tumours are of the size of an apple, they rise suddenly, and if neglected soon become incurable.

Travels into Siberia, p. 353.



CONVULSIVE MOTIONS OR SPASMS seem generally to arise from some peculiar irritation of the nervous system. And whether the brain be originally, or only sympathetically affected, whatever rouses and engages the attention of the mind, will seldom fail to afford relief, by lessening, or destroying the sense of that irritation. Blisters therefore are indicated in such diseases, to stimulate and excite pain in a part of the body that is found. For according to the aphorism of Hippocrates, *Duobus doloribus simul obortis, non in eodem loco, vehementior obscurat alterum.* (a) Dr. Whytt relates the case of a patient, who had an alternate motion of the muscles of the *abdomen*, which was cured by a circular blister, of about eight inches diameter, applied to the part affected. (b) The same author acquaints us, that where epilepsies take their rise from an uneasy

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sensation

(a) Lib. 2. Aph. 46.

(b) Whytt on Nerv. Dif. p. 460.

sensation in some part of the arm or leg, he has found vesicatories, applied to those parts, the most effectual remedies. (*a*)

IN the convulsions which sometimes precede the eruption of the small-pox, blisters act as powerful antispasmodics. But they should not, upon slight occasions, be employed in this state of the disease, lest by their stimulus they aggravate the fever, and increase the number of pustules. When such symptoms occur in the ingrafted small-pox, as indicate the use of vesicatories, it is said that they will succeed the best, if applied to the arms, over the part where the variolous matter was inserted. This I am informed is the present practice of an ingenious physician, and celebrated inoculator, who merits all the honours which have been conferred upon him, by one of the wisest potentates in Europe.

IN

(*a*) Whytt on Nerv. Dis. p. 461.

IN the idiopathic Epilepsy, the application of vesicatories to the head is recommended by Hoffman, Riverius, Piso, and Mead ; who support their recommendation, by many authentic cases and histories. Celsus mentions several remedies for the epilepsy, which are very singular ; such as drinking the warm blood of a gladiator just slain, eating human or horses flesh, or the parts of generation of certain animals. If these things had any efficacy, it must arise from the repugnancy of nature to them, and from the strong and painful sensations of mind, which such shocking and disgusting remedies could not fail to excite. Upon the same principle, Boerhaave cured the epileptics in the poor house at Haerlem. (*a*)

HOFFMAN relates that he has found epispastics of excellent use in the spasmodic asthma ; (*b*) and Dr. Whytt confirms  
P 4 the

(*a*) See the Account in Kaw Boerhaave.

(*b*) Hoffman de Vesicant.

the testimony of Hoffman by his own experience. (a)

IN fixed pains of the bowels from spasms, though there are no evident marks of inflammation, the application of blisters to the *abdomen* may be recommended. Sir John Pringle assures us, that he has oftener than once seen a patient relieved in his bowels, as soon as he felt the burning of his skin; and at the same time have stools by a purge, or a clyster, which had not operated before. In severe, and continued vomitings, when the stomach is affected with very painful convulsive motions, I have observed the most salutary effects from the application of a vesicatory to the epigastric region. Hence we may conclude, that blisters  
act

(a) Nerv. Dif. p. 495. Epispastics have also been found to be very serviceable in the *tussis convulsiva*.

Vid. Ridley's Observ. p. 91.

act not in such cases as evacuants, but as antispasmodics.

3. WHEN THE ACTION OF THE SOLIDA VIVA IS TOO STRONG.

IT is yet a subject of dispute amongst physicians, whether epispastics are useful, or detrimental in inflammatory fevers. Hoffman bears the strongest testimony against their application in such cases; (a) and Baglivi from his own experience asserts, “*Quod delirantibus cum febre acuta, lingua arida, et indicijs magnæ viscerum inflammationis, si applicentur vesicantia, omnia in pejus ruunt, et magna ex parte moriuntur convulsi.*” (b) Alpinus says, *Nunquam probare potui, in acutis febribus, vesicantium usum, quod calorem febrilem augeant, vigilias doloremque concitent, et deliria inducant, coctionem impediant, non minus*

(a) De Vesicant. usu. §. 17.

(b) Praxis. p. 102.



*minus et motui humorum critico obsint, quum incertus sit locus ad quem, vel per quem crisis est futura."* (a) Sir John Pringle acquaints us, that his first practice in every inflammatory fever was to blister; but afterwards, when he found that a solution of the fever was not to be procured by such means, he confined the use of epispastics to those states of the disease, in which he could be most assured of their efficacy. (b) Huxham, if I mistake not, observes that to blister in the beginning of inflammatory fevers is to add fuel to the fire; and Dr. Whytt expressly says, that in fevers, where there is no partial obstruction, or inflammation, vesicatories are of little service, and are sometimes

(a) *Medicin. Method. lib. 5. p. 173.*

(b) IN the second stage of the jail or hospital fever, when the pulse is quick and full, Sir John Pringle hath used blisters, but without success. Nay upon the first attack, the whole head has been blistered, and the oozing kept up for some days, without relieving it, or preventing any of the usual symptoms.

*Dis. of the Army, p. 318.*

sometimes hurtful; unless perhaps towards the end of the disease, when the pulse begins to sink. (*a*)

ON the other hand Sydenham, whose authority must have great weight, from his accurate attention to the *juvantia* and *lædientia* in all diseases, adopted the use of blisters in the continued acute fever, which prevailed in the years 1673, 1674, 1675. The symptoms of this fever, as he describes them, indicate a very high degree of inflammation; and his practice was, first to take away a sufficient quantity of blood from the arm, and then to apply a large epispastic to the neck: At the same time he employed the cooling regimen. Dr. Friend says, that in acute fevers, the safest and most speedy relief is afforded by vesicatories. Nor are we to be too scrupulous about accomodating them to the constitution, or state of the patient;

(*a*) Philos. Transf. Vol. 50. pt. 2. p. 578.

patient; for whatever his habit of body may be, if the fever rages beyond measure, the slight inconvenience of a blister is rather to be endured, than the life of the patient endangered; for in these cases, the only hope is in blisters. They derive the febrile matter from the brain, and assist and promote the other discharges, those especially by sweat and urine. (a) Dr. Glas also, in his learned commentaries, recommends the application of blisters in inflammatory fevers. “ In

*febris inflammatoriis, post debitam sanguinis missionem, locum habet id remedij; atque licet motus arteriarum, etiamnum nimis veloces, ab eo intenduntur, brevi tantum intervallo id fiet, postea quidem, eliquatis densis humoribus, pulsus sentientur molliores, et febres erunt leniores.*” (b)

“ I have more than once in an evening,” says Dr. Lind in his valuable paper on fevers

(a) Vid. Friend de Vesicant.

(b) Glas Comment. p. 235.

fevers and infection, “ordered eight or ten patients to be blistered, and have left them with a quick pulse, great heat, immoderate thirst, a pain, confusion, and heaviness of the head, and what to a physician conversant with such fevers, communicates a most certain knowledge of the condition of the patient, such a lifeless, sunk state of the eyes, as denoted great danger. But the next morning I found these patients with a lively, brisk eye, a calm pulse, and with a desire to get out of bed. (a) Other authorities to the same purpose might be advanced.

How then are we to determine this dispute? May not the truth in this, as in most other litigated points, lie in the middle way between the opposite opinions? If so, the following conclusion may perhaps be justified: That whenever the inflammatory *diathesis* prevails strongly,  
and

(a) Lind on Fevers and Infection, p. 9.



and uniformly throughout the system, and no one part is more affected than the rest, vesicatories are pernicious and detrimental. But when peculiar symptoms of inflammation attack the head, the lungs, &c. and prevail more in those parts, than the rest of the body, blisters are indicated, and often prove remarkably useful. And in such cases they are found from experience, to lessen the impetus of the blood upon the vessels of the inflamed part, to abate the fever and heat of the body, and to diminish very remarkably the quickness of the pulse. (a) Whatever  
may

(a) To understand more clearly the action of blisters in such cases, it is necessary to form a just idea of the nature of inflammation, which seems to consist in an increased alternate contraction of the vessels of the part affected. If the inflammation be large, or the part inflamed very sensible, the whole nervous system will be so affected by the pain, as to render the heart and larger arteries more irritable; and the force of the circulation will, of course, be greatly increased through the whole body. This state is what is called the inflammatory *diathesis*. In the cure  
of



may have been the original cause of a fever, it will be continued, and often greatly increased, by any particular inflammation, which may happen to have taken rise from it. Under these circumstances, the application of a blister to a neighbouring part, will sometimes produce a resolution of the disease, by lessening the impetus of the fluids on the inflamed part, by making a considerable derivation of serous humours from it, and

of inflammation therefore, two indications are to be attended to; 1. to diminish the force of the circulation in general; 2. to abate the action of the vessels in the part affected. The former is to be attempted by venæsection, and the antiphlogistic regimen; the latter by emollient and sedative applications, and frequently by blistering the neighbouring parts. For the impetus of the fluids, in the vessels of the part to which the vesicatory is applied, is much more augmented in proportion, than the force of the circulation in general. And as there seems to be only a certain degree of nervous energy, exerted in the body at one time, the increase of its action in one part, will necessarily diminish it in another. And thus the original inflammation is cured, by exciting another contiguous to it.

and by rendering the mind less sensible of the painful irritation, which excites and continues the inflammation. Upon these principles, I apprehend, we may easily explain the action, and deduce from them the uses of epispastics in the following diseases.

I. IN the SYMPTOMATIC PHRENITIS or DELIRIUM, which accedes indifferently to the bilious, malignant, or inflammatory fever. If the lowness of the pulse admits not of venæsection, the cure must be attempted by leeches and blisters. (*a*) On this subject, Dr. Whytt furnishes us with a practical observation of importance: that in fevers, where the substance of the brain is affected, and not its membranes, he has never found any benefit from the use of blisters. And he always suspects the brain to be affected, when a fever and delirium come on, without

(*a*) *Vid.* Pringle on the Dis. of the Army, p. 138.

without any preceding head ach, or redness in the *tunica albuginea* of the eyes. This kind of fever he has met with several times, and has observed it to be generally fatal. (a) But I have lately had under my care a patient, whose case furnishes an exception to this valuable observation; and as there is something singular and curious in it, it may not perhaps be an useless digression, to give a detail of the most interesting circumstances which attended it.

M. B. a maid servant, aged twenty four, being with child, was turned out of her place, and obliged to go into the poor house, where she remained several weeks after her delivery. But sunk with low diet, oppressed with uneasiness, and exhausted with nursing, she was taken back by her friends, who were assisted in their endeavours to recruit and restore her

Q strength,

(a) *Vid.* Phil. Trans. Vol. 50. pt. 2. p. 578.

strength, by the charitable benefactions of a neighbouring gentlewoman, distinguished for her humanity. August 12th. 1766, a few days after her return home, she was seized with a fever, which begun with a coldness and shivering, and was succeeded by heat. On the 18th I saw her, and found her in a delirium, with a low and feeble pulse. Her eyes were sunk, but without the least redness or inflammation, nor had she complained of any preceding pain in the head. Her urine was sometimes pale, sometimes high coloured. Her skin had that kind of heat, which is not easily described, but which leaves a disagreeable sensation in the hand that feels it. Her tongue was dry and blackish; she had a flushing every now and then in her face, and her belly was immoderately loose; and to all these complaints an almost total deafness was added. In the afternoon there was generally a slight remission of the symptoms.

A LARGE



A LARGE blister was ordered to be laid betwixt her shoulders, and a cordial, diaphoretic, and lightly astringent mixture was prescribed.

AUG. 20. The delirium ceased. Her pulse and heat were natural, her looseness was abated, but her deafness still continued. Two blisters were directed to be applied behind her ears.

21. THERE seemed to be no appearance of fever; and the deafness was going off, though the blisters had not been applied. She complained of a numbness in her right leg, which on examination I found to be cold and motionless. Directions were given to rub it well with the flesh brush, and a large cataplasm of mustard and oat meal *ana p. æ.* was ordered to be applied to her foot.

24th. THE palsy was almost removed.

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In



In other respects she was well, except the pain occasioned by the cataplasm.

30th. SHE had the perfect use of her leg.

SEPTEMBER. 3d. Though the inflammation occasioned by the cataplasm was very inconsiderable, yet she complained of great pain arising from it. Her foot was therefore fomented with a decoction of chamomile and poppy heads, to which a sufficient quantity of milk was added; and afterwards a white bread poultice was applied to it.

5th. THIS morning she was seized with convulsions of the epileptic kind, and had six fits successively. She was cold, feeble and languid, and complained much of sickness and pain in her head. The following medicines were prescribed.

R. *Tinct.*

R. *Tinct. valerian. volat. tinct. fuliginis, ana* ʒss. *laud. liquid. gutt. xl. m. cap. cochl. parv. ij. omni hora, ex cyatho aquæ spiritusque vini gallici.*

R. *Rad. valerian. sylvest. ʒss. aq. fontan. ʒxij. coque parum, et adde asafætid. ʒiss. m. f. enema statim injiciend.*

6th. SHE was better, and had no return of the fits; but complained still of violent pain in the foot.

7th. SHE continued free from the fits. Her head was easier, but her foot was still painful. Yesterday in the afternoon, she was suddenly deprived of her sight, without the least previous pain or uneasiness in her eyes. No inflammation, opacity, or alteration of any kind appeared externally; except that the pupils were more than ordinarily dilated. On holding a lighted candle close to her eye, the pupil did not con-

tract itself, and she had not the least perception of the light. As I apprehended her blindness to be a *gutta serena*, arising from a paralytic affection of the retina, I ordered her forehead to be frequently rubbed with the *liniment. volatile*, made with equal quantities of *ol. oliv.* and *sp. salis ammon. cum calce viva*; and afterwards a flannel, moistened with the mixture, to be left upon the part. It was hoped that by this stimulus, applied immediately to the nerves which issue from the eyes, through the *supra orbital foramina*, the retina might be restored to its proper sensibility. And the event in some measure answered my expectations; for before night, she was able to distinguish the light of a candle. But the recovery of her sight was both imperfect, and of short continuance.

8th. SHE was still blind, and more stupid and heavy than usual. She was frequently sick, and vomited her food,  
but

but refused all medicines. A blister was ordered to be applied to her forehead.

9th. SHE had perfectly recovered her sight. No sooner did the blister begin to operate, but she had a glimmering of light, the pain occasioned a flow of tears, and she was gradually, during the action of the vesicatory, restored to the use of her eyes.

10th. SHE still retained the perfect use of her eyes; was more chearful and lively, had no pain in her head, and complained less of her foot. As she seemed to be in a fair way of recovering her former state of health, I left her, after giving the proper directions with respect to her diet.

N. B. THE young woman continued to recover, and about ten days afterwards I saw her perfectly well.

2. IN OPHTHALMIAS. Inflammations of the eyes are frequently cured, by making a derivation from the part affected, either by means of leeches, or of blisters. Perhaps both might be usefully applied at the same time; the leeches near the external angle of the eye, and the blisters behind the ears; or according to the present more efficacious method of practice, upon the forepart of the head. To conspire with their operation, if the flux of humours to the eyes be great, a brisk purge may be administered, to make a revulsion. And thus, I apprehend, a cure may be compleated, without draining the whole body by large and repeated venæsections. Hoffman dissuades us from applying epispastics to the neck in opthalmias. “ *In optbalmia egregij sunt usus; sed observavi, quod in nucha non adeo conducant, sed potius dolor inde augeatur; quum contra pedibus admota, sæpe simulac*



*simulac humor stillare incipit, dolorem levent."* (a)

3. IN NASAL HÆMORRHAGES, blisters applied to the back have been serviceable; (b) and may we not from analogy conclude, that they would be equally useful in HÆMOPTOES?

4. IN the INFLAMMATORY ANGINA, Sydenham recommends the application of a large, and strong epispastic between the shoulders, having premised bleeding and purging. Sir John Pringle mentions another remedy, whose mode of operation seems to be similar to that of blisters; viz. the application of a piece of flannel to the throat, moistened with two parts of *ol. oliv.* and one of *sp. c. c. vol.* or in such a proportion as the skin will bear. By this means the neck, and sometimes

(a) De Vesicant. usu. §. 12.

(b) Cullen's Clinical Lect.

sometimes the whole body is put into a sweat. But I imagine it is not by the *diaphoresis*, so much as by the revulsion which it produces, that this application is so efficacious: And upon this principle, perhaps a blister would be still more serviceable. Its operation indeed would not be so quick; but the copious derivation of serous humours, from vessels nearly connected with the inflamed parts, would much more than balance the comparative slowness of its operation. (*a*)

5. IN the first stage of the ANGINA MALIGNA, a blister applied to the nape of the neck, or to each side of the throat, produces very salutary effects. But as the skin in this disease is particularly disposed

(*a*) ON looking into the last Edit. of Sir John Pringle's Diseases of the Army, I find a note in which he informs us, that in later practice, besides a blister to the back, in bad cases he lays one across the throat: at other times he has applied seven or eight leeches under the *fauces*, p. 173.

disposed to inflammation, I have seen inconveniences arise from the too powerful stimulus of the cantharides. Of late therefore, I have directed the *emplast. vesicatorium*, of the London Dispensatory, to be mixed with an equal, or double proportion of the *emplast. stomachicum*, and to this composition, have added a drachm or two of camphor, properly comminuted with rectified spirit of wine. Such a plaister I have repeatedly experienced to be sufficiently efficacious as a blister; and the antiseptic ingredients it contains, coincide with the general indication of correcting putrefaction.

If a blister plaister, after being moderately warmed before the fire, be covered with a fine, soft piece of muslin, it will occasion much less irritation, produce no strangury, or but in a slight degree, and, when to be removed, will separate from the skin, with great facility: Nor will such a covering prevent its vesicating effects.

effects. Hence blisters may in this manner, be applied with advantage, whenever the skin is disposed to erysipelatous inflammation from its extreme sensibility; or when their evacuating powers are wanted, with a diminution of their stimulus. In puerperal cases also, they may thus be used, without danger of inflaming the *uterus*, by their action on the urinary passages.

6. IN a true PERIPNEUMONY, especially when the inflammation is great, repeated bleeding is the principal remedy; and Dr. Whytt dissuades us from the early application of blisters. But when the disease is of a mixed kind, when the lungs are not so much inflamed, as loaded with a pituitous matter, when bleeding gives but little relief, when the pulse though quick is small, when the patient is not able to bear evacuations, and the disease hath continued for some time, in such circumstances epispastics will produce

duce remarkably good effects. (*a*) Sir John Pringle says that a pleurisy, taken in the beginning, may often be cured by one large bleeding, and a blister laid to the side affected. If there be no particular stitch, but only a general oppression, the vesicatory may be applied to the back, and afterwards if the disease be obstinate, first to one side and then to the other. Whether applied to the chest, or to the extremities, it will relieve the breast, promote expectoration, and lower the pulse. In pulmonic disorders, Huxham recommends blistering the legs; and he observes that when they ulcerate the extremities severely, they commonly give great relief. (*b*)

7. IN the CHRONIC ASTHMA, when the patients strength is very much reduced,

(*a*) Phil. Transf. Vol. 50. pt. 2.

(*b*) Vid. Essay on Fevers, p. 219. and Obs. de Aere. et Morb. Epid. Vol. 2.



ced, blisters are highly efficacious. But they should never be applied to the chest, when the *dyspnoea* is very severe; because they render the motion of the intercostal muscles more difficult and painful, as well as obstruct respiration by their pressure and tenacity. In these cases volatiles are highly useful.

8th. IN the SMALL POX, when it is attended with rawness, soreness, and great heat in the mouth and throat, and a sharp rheum or stoppage in the nostrils, blisters are found to be very successful. And in this disease, whenever the *membrana schneideriana* is affected, a revulsion from it is indicated; otherwise towards the close of it, the patient will be in danger of suffocation. (a)

9th. IN COUGHS, attended with fever,  
pain

(a) *Vid.* Essay on Fevers, p. 219. and Obs. de Aere. et Morb. Epid. Vol. 2. p. 140, 149.

pain in the side, and a pituitous infarction of the lungs, blisters are highly efficacious, in abating the fever, lowering the pulse, and removing the inflammatory obstruction. This Dr. Whytt hath satisfactorily proved, by a detail of cases, laid before the Royal Society, and published in the *Philos. Trans.* vol. 50.

10th. IN the INFLAMMATION OF THE LIVER, one of the best remedies is a large blister laid over the part affected. (*a*)

11th. IN the INFLAMMATION of the STOMACH and INTESTINES, in the ILEUS and INFLAMMATORY COLICK, epispastics are found to be serviceable. (*b*)

12th. IN the DYSENTERY, when the pains in the belly are too fixed to yield to fomenta-

(*a*) Pringle's *Dis. of the Army*, p. 151.

(*b*) *Ibid.*

fomentations, they are relieved by a blister, applied to the *abdomen*. (*a*)

13th. BLISTERS are remarkably serviceable in the DIARRHOEA, which sometimes attends the MEASLES; probably because they lessen the inflammation, which in this disease falls on the intestines.

14th. IN the RHEUMATISM, SCIATICA, and GOUT, Hoffman commends the use of vesicatories, because they set in motion, and evacuate the supposed acrid matter, which is impacted in the nervous and tendinous parts. Pringle advises their application to the part affected, in the rheumatism and sciatica; and a celebrated Professor at Edinburgh asserts, that they seldom fail of success in the rheumatism, when applied before a swelling of the part comes on. (*b*) Huxham also bears testimony

(*a*) Pringle's *Dis. of the Army*, p. 202.

(*b*) Cullen's *Clinical Lectures*.

testimony in favour of epispastics: “ *In crudelissimo rheumatismo, nihil magis prodest quam vesicatoria, inter scapulas superimposita.* (a)

THUS much for the action of blisters on the MOVING FIBRES. Their operation on the FLUIDS, depends upon their medicinal powers as attenuants, and evacuants; and these, perhaps, arise solely from their stimulus on the solids. By quickening the alternative contractions of the vessels, they prevent the stagnation of the juices; hence their attenuating effects: and by exciting an inflammation externally, they occasion a flux of humours to the skin, and a consequent evacuation of them. It seems therefore to be almost unnecessary, to consider vesicatories as belonging to this second class of medicines. But as some interesting particulars, relating to their operation as evacuants, have

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(a) De Colico Damnoniorum.

been omitted in the preceding part of this attempt to investigate their uses, I shall briefly consider them under this head.

1. IN NERVOUS FEVERS, blisters act not only as a stimulus, but as a drain; and they should not be too soon dried up. Huxham says the more they discharge, and the better it is for the patient: and when the first blisters heal up, he recommends the application of others.

2. In DROPSIES, particularly in the *anasarca*, blisters applied to the legs produce a very copious discharge of serous humours, but they should be used with caution, because they sometimes occasion a spreading, painful, and dangerous inflammation. I was lately witness to a fatal case of this kind. The patient laboured under a dropsy of the *thorax*, and a general *anasarca*. His legs and thighs were swoln to an amazing size.

Vesica-



Vesicatories were applied to the extremities, a little above each ankle, and by unloading the cellular membrane they at first afforded great relief, but in a few days an erysipelas ensued, which extended itself over the whole legs and part of the thighs, producing such excruciating pain, that the patient, whose strength had been before nearly exhausted, sunk under the anguish. — Whenever it is thought expedient to employ blisters, for the removal of anasarcaous swellings, they should be covered with fine, soft muslin, in the manner before described.

3. IN the LYMPHATIC or CRYSTALLINE SMALL POX, vesicatories are recommended as evacuants, both by Huxham and Mead. For by the seasonable discharge of the serosities, the fever, which increases when there is no further derivation of humours to the skin, is happily moderated, if not prevented.

4. IN the WARTY SMALL POX, blisters

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are

are very useful evacuants; because the matter being too thick, can neither suppurate, nor pass off by urine. (*a*)

5. IN the CONVULSIONS to which children are subject, the best practical writers advise the application of blisters, chiefly on account of the drain which they produce. The plenty of nutrition which nature hath provided for the young animal, from the time of its birth, necessarily creates many redundancies, which in a healthy state, are carried off by the glands of the skin, by urine, or by stool. Hence when the infant is arrived to a certain growth, an eruption, called the red gum, usually appears on the surface of the body, and frequently at the same time, there is a discharge from the glands behind the ears, and in the groin. During these excretions, the child for the most part is lively and well; but as the equilibrium  
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(*a*) *Vid.* Mead de Variolis.

of health, in such delicate subjects, is easily disturbed, their continuance is very precarious. And if some new evacuation, be not substituted in the room of them, disease will unavoidably ensue. For so exquisite is the sensibility of the nervous system in children, that a very slight degree of irritation will, in their tender bodies, excite convulsions. In such circumstances, the utility of blisters is obvious, and might be inferred even *à priori*, if experience had not given a sanction to their application. But their good effects are warranted by the most undoubted testimonies. And as a proof how salutary it is, to promote the discharge of the superabundant juices in children, Willis relates the case of a girl, who was subject to the epilepsy, and in one of her fits fell into the fire, and burnt her face and forehead in the most shocking manner. The accident however was attended with this good effect, that as long as the ulcers remained

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open,

open, she was free from the disorder. Hollerius furnishes us with a similar example. A girl had from her infancy a running sore in her head: It was suddenly healed up, and she became epileptic. Variety of remedies were tried to no purpose: Duretus was consulted, who recommended the application of beet leaves to her head, which brought on a large discharge, and removed her epilepsy. (a) Agreeable to this is the observation of Hippocrates, that running sores of the head happening to children, prevent the convulsions. “*Quibuscunque quidem pueris existentibus, erumpunt ulcera in caput, et in aures, ac in reliquum corpus; et qui salivosi fiunt, ac mucosi, hi ipsi in progressu ætatis facillimè degunt: Qui vero mundi sunt, et neque ulcus ullum, neque mucus, neque ulla saliva prodit, neque in uteris purgationem fecerunt, talibus periculum imminet, ut ab hoc morbo (i. e. epilepsia) corripi-*

(a) Boerhaave de Morb. Nerv. p. 820.





moted by proper applications; and the patient grew up to woman's estate, without ever suffering any return of the dreadful disease, under which she had laboured. Celsus in the epilepsy recommends scarification, and the application of cupping glasses to the *occiput*; (a) and as this disease frequently arises, especially in children, from plenitude, and a redundancy of humours in the head, a drain made from that part, may justly be regarded as a probable means of cure.

(a) Lib. 3. Cap. 23.

E S S A Y V.

A N I N Q U I R Y

I N T O

T H E R E S E M B L A N C E

B E T W E E N T H E

C H Y L E

A N D

M I L K.

—— *Probabilia conjectura sequens.*

Cic. Tusc. lib. 1.

## E S S A Y V.

### AN INQUIRY INTO THE RESEMBLANCE BETWEEN CHYLE AND MILK.

**T**HE properties of milk have with great ingenuity been investigated, and with equal precision ascertained, by several medical writers; and if the nature of the chyle were as well known, the subject of the present inquiry, would be obvious, and of easy solution. But as this fluid cannot, without great difficulty, be collected in sufficient quantity, to undergo an experimental examination, it is almost impossible to determine its qualities,

ties, with any considerable degree of certainty. Nor have I, in a great variety of authors which I have consulted, met with one experiment, which has been made immediately on the chyle, taken from the lacteal vessels. We must therefore content ourselves, with attempting to determine *à priori*, its nature and properties; that by comparing these with the known qualities of milk, some probable conclusions at least may be deduced. And these conclusions may be confirmed by other arguments, drawn from facts and observations.

I. THE chyle must necessarily be composed of the food we eat; which being masticated in the mouth, and mixed with the fermentable saliva, is carried into the stomach, where it receives the addition of the *succus gastricus*, is further broke down, ferments, and passes over the *pylorus* into the *duodenum*. Here it mixes with the bile, cystic and hepatic, with  
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the *succus pancreaticus*, and the lymph which is thrown out, from the exhalant arteries, into the intestines. At length, if the animal feed chiefly upon vegetables, it is changed into a white and saccharine fluid, which being imbibed by the lacteals, is carried into the course of circulation, to be further assimilated, animalized, and converted in *succum et sanguinem*.

THE fluid thus formed, in all probability consists of oil, mucilage, water, a coagulable part, and fixed air. That oil and mucilage enter into its composition, may be presumed from the whiteness of its colour ; for these two substances, when intimately combined with water, always put on that appearance. The existence of a coagulable part in the chyle, is rather more uncertain ; but I think there is some foundation for the hypothesis. Our food is mixed in the *primæ viæ*, with a considerable quantity of lymph, which  
as

as it is composed of the serum of the blood, must be of a coagulable nature. And the mucilage contained in the aliment itself, possesses also in some degree the same property. So that we may with probability conclude, that the chyle is not destitute of a coagulable part. This coagulable part of the chyle, may possibly owe its origin, as much to the peculiar process of fermentation, which takes place in the *primæ viæ*, as to the animal fluids which are mixed with our food, in its passage through the stomach and small intestines. And this fermentation depends, in a great measure, on the nature of the aliments ingested. For it is observed, that a cow which feeds upon rank and watery grass, yields milk that contains very little *crassamentum*, and is therefore unfit for the purpose of making cheese. That fixed air enters into its composition, is acknowledged by every one, and has lately been very ingeniously illustrated,

illustrated, by the experiments of Dr. Macbride.

BOERHAAVE and other chemical writers, endeavour to explain the formation of chyle, by the instance of an emulsion, which is made by triturating any of the oleaginous vegetables with water. But the analogy between them is very imperfect, and perhaps only subsists in this single particular, that the white colour of each fluid arises from the mixture of oil and water, by the intervention of mucilage.

2. MILK consists of oil, mucilage, sugar, water, and air. The oil is obtained by a spontaneous separation, and is called cream. The mucilage is that coagulable part of which cheese is made. It has often been compared to the serum of the blood; but differs from it in this essential particular, that it is not coagulated by heat. The water contains a quantity of  
sugar,

sugar, which may be separated from it, by evaporating with a gentle heat, and crystallizing. That air is present in milk may be made evident to the senses, by placing a quantity of it, previously heated, under the receiver of an air pump.

THE bare enumeration of the above particulars is sufficient to shew, the similitude which subsists between the two animal fluids, which form the subject of our present inquiry. And, if it could be satisfactorily ascertained, that the properties, and component parts of the chyle are justly laid down, this exact resemblance, would prove beyond all doubt, that they are one and the same. But, unfortunately, it cannot; and as my conclusion is founded upon hypothesis alone, it is necessary to support it by arguments, drawn from facts and observations.

I. MILK, as to its properties, depends upon the aliment. “ *Pro vi et differen-*

*tia*

*tia assumptorum lac diversum esse; ex illis enim chylus melior vel deterior, dulcis vel amarus, ex hoc tale lac; qualia enim ingesta, talis chylus, qualis chylus, tale lac, assertum quotidiana confirmat experientia."* (a)

Dioscorides relates, that the milk of goats which fed on the scammony plant and sparges, proved cathartic; and instances have been known, of an animal yielding bitter milk, from having eaten wormwood. (b) If a nurse take a purgative, the infant will be purged; if she drink wine or spirituous liquors, it will be intoxicated; (c) and I have been informed, from good authority, of one instance, where the eating of cabbage, or other flatulent vegetables, always gave the child the windy gripes. Milk, and the butter made from it, are found to differ greatly in colour, consistence, taste,

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and

(a) Crantz M. M. p. 80.

(b) Vid. Lewis's Mat. Med. p. 330.

(c) Vid. Boerhaav. Prælect. §. 690.



and smell, according to the food of the animal. Human milk is made yellow by taking saffron, bitter by wormwood, and impregnated with a garlic smell, by eating that root. (*a*) Boerhaave relates that thick ale, taken by a fasting nurse, hath in a short space of time been discharged through the breasts. (*b*) These instances shew, that milk retains all the adventitious properties of the chyle; we may therefore conclude by analogy, that the natural and peculiar qualities of that fluid remain also unchanged.

2. THE milk is proportioned in quantity, to the quantity of chyle. If the animal fast for a long space of time, neither chyle, nor milk is generated. The milk which is secreted immediately after taking in food, is found to be crude and indigested; because it proceeds probably from the juices of the aliment, which are carried

(*a*) *Vid.* Neumann's Chemistry, p. 569. Notes.

(*b*) *Prælect.* §. 688.

ried into the system by the absorbent vessels, before the chylous fermentation, if that expression be allowable, is perfected. A nurse yields the best milk about four hours after a meal; for by that time, the process of digestion is fully compleated. In about eight hours, the chyle begins to be assimilated to the nature of the animal fluids, and then the milk assumes a yellowish colour, and acquires an offensive taste and smell. At length, when the chyle is converted into blood, the secretion from the breast, no longer bears any resemblance to milk, but becomes acrid, fetid, and in every respect the reverse of that mild, sweet, and agreeable fluid.

3. THE saccharine substance, which may be obtained from milk by inspissation and crystallization, and the inflammable spirit, by fermentation and distillation, together with its acescent quality, in which it differs from all the other animal fluids, shew that the vegetable nature

of the chyle is unaltered in the vessels of the breast. (*a*)

4. THAT the chyle may pass through the course of circulation, without immediately mixing with the animal fluids, appears from the example of water, which is sometimes secreted by the kidneys of hysterical persons, perfectly pure and infipid. And that it really does, is evident from venæsection: for the chyle hath been seen floating on blood, recently drawn from the arm. In the last stage of a diabetes, the urine manifestly points out the presence of chyle in it, by its white colour, saccharine taste, and acescency. If it be kept in a close vessel seven or eight days, it will become sour, and ferment strongly with any of the mild alkaline salts. The learned Baron Van Swieten says, that a milky discharge hath

(*a*) If an animal feed upon vegetable diet, the milk will be saccharine and acescent; if upon animal, no sugar will appear in that fluid, but on the contrary it will be putrescent.

*Vid.* Young Dissert. Inaug. Cap. viii. p. 55.

hath been observed in diarrhœas. (*a*) And Mr. Patch, in the Edinburgh Medical Essays, relates the case of a boy, from whose groin issued, through a small and almost imperceptible orifice, four or five pints of a liquor like milk. (*b*)

5. THE remarkable laxity of the vessels of the breasts, aided by the power of suction, in diminishing the resistance which the fluids might meet with in their passage through them, renders it probable, that the chyle may easily pass into the breasts, and be secreted there unchanged.

6. BUT the following history, which fell under the inspection of a very celebrated physician, and was communicated to me by his friend and correspondent, puts the matter almost beyond dispute. I shall therefore conclude this inquiry with the detail of it. A girl about

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eight

(*a*) Van Swieten Comment. §. 1329.

(*b*) Edin. Med. Essays, Vol. 5.



eight years old, was tapped for an *ascites*. She had also an universal *anasarca*; and even her face was very much bloated, and exceedingly pale. Four quarts of liquor were drawn off, which was of a milky colour, full as white as milk mixed with an equal quantity of water. It would not coagulate by heat; but after standing a day or two, it was covered with a kind of thin cream, and in a few days more, it smelt, and tasted sour. The girl was greatly relieved by this evacuation; but the tumour of her belly, soon increased again to such a degree, that it was necessary to renew the operation. A liquor the same as before, only somewhat more dilute, was drawn off, the swelling of her whole body subsided, and she recovered her appetite and strength. This girl before she was attacked with these complaints, was very lively and active, and had a great appetite, in which she was too much indulged. Probably by using violent exercise after a full meal, she had ruptured some of the lacteals.



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A N

A P P E N D I X.

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*Sapientis medici est, eorum locorum aquas  
ubi medicinam facit, convenienti examine  
probè scrutari, quo postea cum fructu,  
tam præservandi quam sanandi gratia,  
iis uti posset.*

HOFFMAN.

EXPERIMENTS  
AND  
OBSERVATIONS  
ON  
WATER:  
PARTICULARLY ON THE  
HARD PUMP WATER  
OF  
MANCHESTER.

THE SECOND EDITION, REVISED AND ENLARGED.

— *Sanctos ausus recludere fontes.*

VIRGIL.

T H E

## I N T R O D U C T I O N.

**T**HE extensive influence of WATER on the health of mankind will, it is hoped, appear sufficiently evident from the following Essay. The author proposed to have enlarged the subject of it, by enquiring into the effects of hard and soft water on a variety of the common arts of life, such as Brewing, Malting, Dying, Bleaching, Tanning, &c. &c. But he found the subject too copious, to be reduced within the bounds which he had prescribed to himself; and that the prosecution of it, would too much abstract his attention from those favourite studies, which more immediately belong to his profession.

AN analysis of the waters, which are the objects of this enquiry, by means of evaporation, crystallization, &c. might perhaps



perhaps have ascertained their contents with more minute exactness. But even this method is attended with some disadvantages ; because heat decomposes many saline bodies ; and to determine the composition of the *residuum*, recourse must have been had to the same chemical tests, which the author employed in his experiments. And it would have been an almost endless trouble, thus to analyse thirty different pump waters.

THIS Essay was intended only to be communicated to the ROYAL SOCIETY : And many of the experiments contained in it, have been read before that learned body. But the importance of the subject, and a desire of rendering his little work more extensively useful, hath induced the author to publish it. And he flatters himself, that he shall at least be justified by the motives, if not by the success of his undertaking.

MANCHESTER, Nov. 1, 1771.

EXPERIMENTS  
AND  
OBSERVATIONS  
ON  
WATER.

SECTION I.

**I**T is a maxim of the divine Hippocrates, that whoever would apply with success to the study of physick, should acquaint himself with every circumstance relating to the situation of the place wherein he practises, the nature of the seasons, the influence of the winds, and the particular qualities of the water. The last object is by far the most important; because as a fixed and permanent

nent cause, its effects will be regular, uniform, and constant. For whether the simple element itself be used, or it be mixed with vinous liquors, or brewed into beer, it will still retain in some measure its peculiar properties, and if impure, will gradually produce some morbid changes in the body. On the robust indeed, its action may perhaps be slow, and imperceptible; but the tender and valetudinary will find themselves sooner and more sensibly affected by it. Many of the diseases of children, it is more than probable, owe their rise to this necessary diluent and vehicle of their food. And if we consider that numberless chronic disorders have their foundation laid in the state of infancy and childhood, the influence of water on the health of mankind will appear to be very extensive, and deserving of our strictest attention and regard. It would be no difficult matter to prove, that a considerable number of those distempers, which from their being peculiar to certain people and places,

places, are termed endemic, are chiefly the effects of this powerful and active cause. Thus the inhabitants of the Alps, the Pyrenees, and of many other mountainous countries, are subject to a monstrous external swelling of the glands of the neck, owing as it is universally acknowledged, to the peculiar properties of the water they drink. (a) “As you advance towards Mount Cenis, says Mr. Sharp, in his excellent Letters from Italy, you find very few exempt from these tumours, which are so enormous, and of so loathsome an appearance, especially in ugly, ragged, half-starved old women, that the very sight of them turns the stomach. I was curious in my examination, whether any children are born with this malady upon them: I was informed, that there is no such instance; and even that the swelling never begins to form till towards two years of age; some examples of

(a) *Quis tumidum guttur miratur in Alpibus?*

Juvenal. Sat. 13.

of which I myself saw." (a) Nor is this distemper peculiar to the natives of those countries; for strangers become affected with it, after residing there a few years. (b) And such is the influence of custom on the common people, that they regard this blemish as a beauty, and even ridicule those who are destitute of it. At Rheims, the capital of the province of Champagne in France, there is hardly an aged person free from the *bronchocèle*, owing to the drinking, till of late, the common water of their wells, which runs through a kind of chalky quarry, with which it is strongly charged. The same effect has been observed to arise from the abuse of sea water. (c) The inhabitants of the village of Steinsseffeln, in the district of Schmiderberg, are said to have freed themselves from this malady, by abstaining from certain fountains, which  
were

(a) Sharp's Letters, p. 298.

(b) Hoffman. Op. Tom. 6. p. 202.

(c) Vid. Lucas on Waters, Vol. 1, p. 29.



were observed to produce it. (*a*) In two cities of Hercynia, Wildeman, and Andreasberg, which are built upon a large bed of minerals, scarcely a woman is to be found, who does not labour under strumous swellings of the throat, occasioned it is justly supposed, by the constant use of hard, metallic, and calcareous water. (*b*) The men too, in all probability, are not exempt from them; but as the female part of our species have more delicate constitutions, and especially a much greater degree of laxity in their glandular systems than we have, the same causes which but slightly affect the one sex, may prove highly injurious to the other. The people of Siberia, who live near the river Kirenga, which is remarkable for its impurity, are almost universally affected with scrophulous disorders; and strumous swellings are common, even amongst the cattle of that country.

(*a*) Hoffman. Op. Tom. 6. p. 203.

(*b*) Id.

try. (a) It is worthy of observation, that horses, by an instinctive sagacity, always prefer soft water, to that which is hard. And when by necessity or inattention, they are confined to the latter, their coats become rough, and they are subject to the gripes.

HIPPOCRATES asserts that hard waters, which are unfit for boiling, dry and astringe the belly; and that such as are stagnant and ill-scented, injure both the belly and spleen. (b) In confirmation of this, it may be observed, that in Minorca, where the water which the springs and rivulets afford, is often brackish, and always hard, obstructions, indurations, and swellings of the abdominal viscera, together with flatulency and indigestion, are the most common diseases to which the inhabitants are subject. And it is remarkable, that large spleens and tumefied

(a) Comment. Lips. Tom. 2. p. 103.

(b) Hippoc. de Aere, Aquis et Locis.

mesfed livers are not peculiar there to the human species, but are incident also to brutes; especially to the sheep, which feed on the eastern side of the island, where the waters are particularly brackish. (*a*) This shews the wisdom of the ancients in examining the livers of the cattle which they offered in sacrifice, wherever they proposed to build a town, or to pitch a camp. If they proved to be firm and sound, there they planned settlements, and erected fortifications. But on the contrary, if the livers appeared to be lax in their texture, or in any respect diseased, they speedily decamped; justly concluding, that the same food and water would produce a similar effect, in human bodies. (*b*)

PLINY mentions a fountain in Æthiopia, about which a large quantity of native cinnabar was found, and which pro-

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duced

(*a*) *Vid.* Cleghorn on the Dis. of Minorca.

(*b*) Vitruvius, Lib. 1. Cap. 4.

duced its deleterious effects chiefly on the brain. (a) And Athenæus, speaks of a spring in Paphlagonia, to which the inhabitants of the country frequently resorted, which had an inebriating quality. Ovid poetically describes such waters in the following lines.

*Cui non audita est obscenæ Salmacis undæ,  
 Æthiopesque lacus? quos si quis faucibus hauset,  
 Aut furit, aut patitur mirum gravitate soporem.*

Metamorph. lib. 15, 317, 321.

THE *Plica Polonica*, a singular disease to which the inhabitants of Poland and Lithuania are subject, and which consists in a præternatural enlargement and convolution of the hair, is in part ascribed by a very celebrated writer, to the use of impure water. *Morbi hujus causa valde perplexa & difficilis videtur, nihilominus eam, quantum fieri poterit, indagare allabora-*

(a) Plin. Hist. lib. 31. c. 2.



*allaborabimus. Primo multum sordidum vitæ genus confert, cui hi populi addicti sunt; dum raro crines pectunt in humidis et depressis locis dormiunt, et spiritum vini liberalissimè ingurgitant. Suum quoque symbolum AQUÆ contribuunt; hinc non malè Gebema in Epistola ad Bontekoe, de Plica Polonica pag. 10. sentit, hæere vitium in nonnullis Poloniae aquis, &c.*

——— *Nos supponimus quoddam vitium hæreditarium, quod in nimia pororum et bulborum capillorum sub cute in capite consistit; unde succus nutritius, crassius, et glutinosus, prava diæta ex CRUDIS AQUIS productus, calore, quem potus spiritus vini conciliat, urgetur ad tubulos capillorum, ex quorum poris exsudat, et monstrosam illam intricationem efficit. (a)*—This supposition of the learned Hoffman is confirmed by the following aphorism of Sanctorius. Heavy water and a foggy air, convert the matter of perspiration into an ichor,

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which

(a) *Vid. Hoffman. Op. Tom. 6. p. 205.*



which when retained in the body, induces a cachexy. (*a*)

DR. MEAD in the first edition of his Essay on Poisons, relates the case of a lady, whose life was formerly imbibited by the frequent returns of violent colic pains, till she was happily advised by her physician, not to drink, as she usually did, beer brewed with well water. And so evidently was the establishment of her health owing to this caution, that the neglect of it was always attended with a return of her disorder. A fact similar to this is recorded by Van Helmont, of the monks belonging to a certain monastery near Brussels, who were always affected with the gripes by the water which they used, unless they corrected its effects by boiling wild carrot seeds in their beer. (*b*)

THE

(*a*) Sanctor. Med. Stat. Sect. 2. Aph. 6.

(*b*) Helmont's Lithiasis.—*Vid.* also Hale's Stat. Essays, Vol. 2. p. 248.

THE *Elephantiasis* is endemial amongst the Egyptians, (a) and is ascribed by Galen and Avicena to the use of the impure waters of the Nile. Lucretius also adopted the same opinion, as appears by the following lines.

*Est Elephas Morbus, qui propter  
flumina Nili  
Gignitur Ægypto in medio. ———*

IT is an opinion which the father of physick first advanced, and which has been almost universally adopted by his followers, and hath remained till lately uncontroverted, that the stone and gravel are generated by the use of hard water. *Damnantur imprimis fontes*, says Pliny, *quorum Aquæ decoctæ, crassiss obducunt vasa crustis.* (b) And from this quality, which the waters of certain springs possess, of depositing a large earthy sedi-

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ment,

(a) Alpinus de Med. Ægypt. Lib. 1. Cap. 4.

(b) Lib. 31. c. 3.

ment, either in the aquæducts through which they are conveyed, or in the vessels in which they are boiled or preserved, it was obvious to infer, that in passing through the kidneys, and especially whilst retained in the bladder, they would let fall their grosser particles, which by the continued apposition of fresh matter, connected by the animal gluten, and compacted by the muscular action of that organ, would in time form a *Calculus*, sufficiently large to produce a train of the most excruciating symptoms. And this reasoning *à priori*, has been supposed to be confirmed by facts and experience; for not to mention the authority of Hippocrates, Dr. Lister has observed, that the inhabitants of Paris, are peculiarly subject to the stone in the bladder. (a)

And

(a) *Vid.* Lister's Journey to Paris.

NICHOLAS DE BLEGNY has related the history of one who was dissected at Paris, in whom the Pylorus, a great part of the Duodenum, and the stomach itself, were found incrustated with a stony matter, to the thickness of a  
finger's

And it is well known, that the water of the river Seine, with which that city is supplied, is so impregnated with calcareous matter, as to incrustate, and in a short time to choak up the pipes through which it runs. But on the other hand it is objected, that the human *Calculus* is of animal origin, and by chemical analysis, appears to bear very little analogy to the stony concretions of water. And though it is allowed, that more persons are cut for the stone in the hospitals at Paris, than in most other places, yet upon enquiry it is found, that many of those patients come from different provinces, and from towns and villages far distant from the Seine.

I WILL not presume to decide this disputed point: but if I may be allowed to indulge a conjecture, I should suppose, that though this disease may chiefly depend

finger's breadth. Zodiac. Med. Gallic. A. D. 1679.  
Mens. Feb. Obf. 3.



pend upon a peculiar disposition to con-  
crete in the animal fluids, which in ma-  
ny instances is hereditary, and in no in-  
stance can with certainty be imputed to  
any particular cause ; yet, hard water is  
at least negatively favourable to this *dia-*  
*thesis*, by having no tendency to diminish  
it. The urine of the most healthy per-  
son, is generally loaded with terreous  
matter, capable, in favourable circum-  
stances, of forming a *Calculus* ; as is evi-  
dent from the thick crust which it de-  
posits, on the sides of the vessels in which  
it is contained. And it seems as if na-  
ture intended by this excretion, to dis-  
charge all the superfluous salts of the  
blood, together with those earthy parti-  
cles, which are either derived from our  
aliment, and fine enough to pass through  
the lacteals, though insuperable by the  
powers of circulation, or which arise  
from the abrasion of the solids, or from  
the dissolution of the red globular part  
of our fluids. Now water, whether us-  
ed as nature presents us with it, or mix-  
ed



ed with wine, or taken under the form of beer or ale, is the great diluter, vehicle, and *menstruum* both of our food, and of the saline, earthy, and recrementitious parts of the animal juices. And it is more or less adapted to the performance of these offices, in proportion to its degree of purity. For it must appear evident to the most ordinary understanding, that a *menstruum* already loaded, and perhaps saturated, with different contents, cannot act so powerfully as one which is free from all sensible impregnation. Nor is this reasoning founded upon theory alone; (a) for it is observed, that MAL-

VERN

(a) A gentleman of this place, who had been long subject to nephritic complaints, and often voided small stones, was advised to refrain from his own pump water, which is uncommonly hard, and to drink constantly the softer water of a neighbouring spring. And this change alone, without the use of any medicine, hath rendered the returns of his disorder much less frequent and painful. A lady also, much affected with the gravel, was induced by the perusal of the first edition of this essay, to try the effect of soft water; and by the constant use of it, she has remained two years entirely free from her disorder.

VERN WATER, which issues from a spring in Worcestershire, remarkable for its uncommon purity, hath the property of dissolving the little fabulous stones, which are often voided in nephritic complaints. And the solution too, which is a proof of its being complete, is perfectly colourless. Hence this water is drunk with great advantage in disorders of the urinary passages. And during the use of it, the patient's urine is generally limpid, and seldom deposits any sandy sediment. Yet notwithstanding this appearance of transparency, it is certainly at such times, loaded with impurities, which are so diluted and dissolved as not to be visible. For it is attended with a strong and fœtid smell, exactly resembling that of asparagus. (a) Hoffman mentions a pure, light, simple

(a) *Vid.* Dr. Wall on Malvern Water.

IN Nephritic cases, distilled water would be an excellent substitute for Malvern Water, as the following experiment evinces.

simple water in the principality of Henneberg, in Germany, which is remarkable for its efficacy in the stone and gravel; and a water of similar virtues, was discovered not many years ago, in the black forest, near Osterod, which upon examination did not afford a single grain of mineral matter. Indeed it is worthy of observation, that most of the springs, which were formerly held in great esteem, and were called *holy wells*, are very pure, and yield little or no sediment.

THESE observations are sufficient to shew the utility and importance of the following chemical enquiry, into the nature and properties of the PUMP WATER  
of

Two fragments of the same Calculus, nearly of equal weights, were immersed, the one in three ounces of distilled water, the other in three ounces of hard pump water. The phials were hung up close together, in a kitchen chimney, at a convenient distance from the fire. After fourteen days maceration, the calculi were taken out, and carefully dried by a very gentle heat. The former, viz. that which had been immersed in distilled water, was diminished in its weight a grain and half; the latter had lost only half a grain.

of MANCHESTER. I shall therefore proceed to lay before the reader the most interesting of my experiments on this subject, with such inferences as are obviously deducible from them.

### EXPERIMENT I.

NEAR thirty different pump waters, most of them collected from pumps common to a whole neighbourhood, were chemically examined. They all curdled soap; the volatile alkali occasioned a precipitation in many of them; the fixed alkali in all of them; and they became quite milky with a solution of *sacharum saturni*. The infusion of galls produced no change in their colour; but syrup of violets turned most of them green.

### EXPERIMENT II.

A THREE ounce phial, after being carefully counterpoised in a very nice balance, was filled to the brim with distilled



tilled pump water, which weighed twenty one drachms and fifty grains. The same phial, exactly balanced as before, was then filled to the brim with my own pump water, of the same temperature with the distilled water, which weighed twenty one drachms and fifty six grains. (*a*) Several other pump waters were examined in the same way, and very little difference was found in their specific gravities. The water of a pump belonging to a public brewery in this place, weighed indeed, in the quantity above-mentioned, only twenty one drachms and fifty three grains. But on enquiry I learned, that this water is contained in a reservoir, supplied by means of pipes, either from the rain which falls in the neighbouring grounds, or from the superficial springs which run through them.

FROM

(*a*) THIS experiment was afterwards tried by the hydrostatical balance, with no other difference in the result, but a small fraction of a grain.



FROM the foregoing experiments it is obvious, that the pump water of Manchester is in general very impure. It is impregnated with a large quantity of felenite; an earthy, astringent salt, composed of the vitriolic, nitrous, or marine acid, and calcareous earth; and at the same time contains no inconsiderable proportion of alum, as may be reasonably inferred, from the green colour which it strikes with syrup of violets. For though it be acknowledged, that Buxton, Bristol, Pyrmont, Spa, and other springs, which are not aluminous, produce a similar effect, yet these are all impregnated with mineral alkali, or with other substances, of which the Manchester pump water appears to be destitute, by the chemical tests employed in its examination. (a) But what puts this conclusion beyond

(a) DR. LEWIS asserts in his *Materia Medica*, p. 71. "that the blue juices of vegetables are changed red by alum;" and again in his excellent notes on Neumann's Chemistry,

beyond dispute is, that the earth of alum is frequently found in the wells of this town. I have now in my possession some of this earth, which by the addition of oil of vitriol, has been converted into true alum.—From the second experiment it is evident, that a quart of water contains upwards of sixty grains of adventitious matter; and supposing this quantity to be daily consumed, in one way or other, by every individual, which is a moderate

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compu-

Chemistry, p. 252. “that syrup of violets is changed red by waters impregnated with alum.” The fact was otherwise in my trials; for two grains of alum dissolved in an ounce of distilled water, struck a pea green with twenty drops of the same syrup of violets, which was used in the above recited experiments. A tea-spoonful of lime water added to a part of the solution, considerably deepened the green colour; whereas two drops of elixir of vitriol produced in the other part a sensible, though faint redness. A solution of alum also in lime water was turned at once into a deep green, by the addition of a small portion of syrup of violets. The lime water was added in the first experiment, to render the water employed more analogous to the hard, calcareous pump water of Manchester.

In a later trial I have found that the blue or purple juice of radishes is changed to a red, so slight however as  
barely

computation, about forty six ounces troy weight, of crude, earthy, indigestible, and by no means inactive salts, will in the course of twelve months, be received into the body. And how pernicious this may be to health, those can best conceive, who know the powerful influence of slight, but continued causes on the human frame. (a) It would be foreign  
to

barely to be perceptible, by a solution of alum in water. But this does not invalidate my conclusion, that many of the pump waters of Manchester are aluminous, because they are turned green by an admixture of syrup of violets. For it appears, that a solution of alum produced a green colour in the same syrup of violets, which was employed in the before-mentioned experiment. And to secure against all fallacy, I repeated that experiment several times: nor had I reason to suspect the genuineness of the syrup, as it was prepared at the Apothecary's Hall, and never failed to become red, on the addition of an acid. The result of it is also corroborated by the testimony of Neumann, who asserts, that the common sorts of alum change the syrup of violets green. Dr. Rutty says, that syrup of violets when new is turned red, but when kept some time green, by alum.

(a) *Quid magis est saxo durum? Quid mollius unda?*  
*Dura tamen molli saxa cavantur aqua.*

Ovid.

to my present purpose, to enter into a detail of the endemic diseases of Manchester. But one observation I cannot omit, that the inhabitants of this place are peculiarly subject to glandular obstructions, and scrophulous swellings. And that water loaded with astringent, earthy salts, hath a direct tendency to produce such complaints, has been already I hope fully evinced.

BUT hard and impure water may be considered in a further view as injurious to the human body. It was before observed, that this universal *menstruum* is designed by nature to be the diluter, vehicle, and solvent both of our food, and of the recrementitious parts of the animal fluids. And in the performance of these salutary offices, it immediately promotes the general health of the body, and at the same time counteracts the influence of various causes of disease. The Spaniards, it is said, are for the most part exempt from the itch and the scurvy, notwithstanding

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standing they indulge themselves in the daily use of pork, the least perspirable of all foods. And the reason assigned for this remarkable fact is, that the air of Spain is clear, thin, and serene, and the water light, pure, and wholesome. (*a*) Hence the minutest series of vessels are continued permeable and unobstructed, perspiration is free and copious, all the excretions are duly and regularly performed, and every thing putrid and acrimonious is carried out of the system, before it has time to create disturbance or disorder. But water impregnated with austere, earthy, and indigestible salts, is ill qualified to answer these important ends. Already nearly saturated with its heterogeneous contents, it is rendered less capable

(*a*) *Vid.* Hoffmani Opera, Tom 6. p. 204.

HERODOTUS, whose testimony is not always to be depended upon, relates that in Æthiopia the inhabitants live to be an hundred and twenty years old, that they eat flesh, and drink milk; that the water of the country is so light, that nothing will float upon it, not even wood, and that the use of this water makes them long lived.

Lib. 3. c. 125.



capable of dissolving our food, of mingling uniformly with our fluids, or penetrating the finest ramifications of the vascular system, and of passing off copiously and easily by the several emunctories. And thus it becomes negatively the cause of diseases.

It is therefore of the utmost consequence, where nature hath denied the benefit of pure water, to discover some means of correcting its pernicious qualities. And with this view the following experiments were made.

### EXPERIMENT III.

A STRONG solution of salt of tartar was instilled into hard pump water, till no lactescency ensued. The same experiment was repeated with a smaller quantity of *sal tartari*, so as not to destroy the insipidity of the water; but the softening effect of the vegetable alkali, was then scarcely perceptible. Hence it appears

that the Manchester pump waters, are too hard to be much improved in this way, without rendering them offensive to the palate.

#### EXPERIMENT IV.

To half an ounce of hard pump water, just boiled, were added five drops of a solution of *sacharum saturni*. To an equal quantity of the same water unboiled, were also added five drops. The boiled became much less milky than the cold water. But supposing this effect to arise from the heat of the water, I poured half an ounce of it into a glass, and when cold, instilled five drops of the solution of sugar of lead into it as before, without any increase of its lactescency. I then took equal quantities, viz. half an ounce of unboiled water, and of water which had been boiled over a brisk fire during the space of twenty minutes, and poured into each a few drops of the solution of *sacharum saturni*. The raw water became twice as  
milky

milky as the boiled water, and deposited a much larger sediment. And I thought the water which had been boiled twenty minutes, was less changed by the addition of sugar of lead, than that which had undergone only a slight coction. Ten drops of *sp. sal. ammon. vol.* added to half an ounce of raw spring water, turned it milky; but when added to an equal quantity of the same water which had been boiled twenty minutes, no change was produced. Three grains of fixed alkali (*sal tartari*) dissolved in half an ounce of the same boiled water, occasioned no sensible cloudiness; but when mixed with an equal quantity of raw water, a great lactescency and copious precipitation immediately ensued. The boiled water still continued to break and curdle with soap, though in a less degree than the same water unboiled. The former also felt to the touch much softer than the latter.

THIS experiment clearly demonstrates,

U 4.

that

that hard water is freed from some of its earthy salts, and rendered considerably softer by boiling. And it appears likewise, that the coction should be continued some time, in order to produce its full effect. Dr. Heberden is indeed of a contrary opinion; for notwithstanding he acknowledges, that the unneutralized lime-stone and selenite is separated by boiling from pump water, yet he thinks it becomes more strongly impregnated with the saline matter, and consequently less salutary. But in this instance, the Doctor appears not to reason with his usual judgment and accuracy; and I apprehend, his observation is neither confirmed by analogy, nor supported by experiment. For though heat generally increases the dissolving power of any *menstruum*, at the same time it tends, in many instances, to destroy the texture, and disunite the component parts of the solvend. Thus hot water suspends a much larger quantity of nitre than cold water; but if the solution be boiled over  
the



the fire, a considerable portion of the salt-petre will be dissipated. If then the nitrous acid be volatilised and separated from its alkali by coction, may we not justly infer, that it will be disengaged by the same cause from an earthy basis, to which it bears comparatively but a weak affinity? And the same reasoning may be applied with equal force to the volatile vitriolic or muriatic acids, which in all probability fly off by means of the boiling heat, leaving behind them an indissoluble, petrifying earth, that subsides to the bottom, and incrusts the vessel.

#### EXPERIMENT V.

A quantity of hard pump water, which had passed through a filtering stone, when compared with the same water unfiltered, was found to be considerably softened. Each curdled with soap, but the former in a less degree than the latter. The volatile alkali occasioned no cloudiness in the filtered water, but a visible one in  
the



the other : The fixed alkali produced a precipitation in both, less however in the former, than in the latter ; and the solution of *sacharum saturni* rendered the unfiltered water much more lactescent, than that which had soaked through the filtering stone.

THESE two experiments point out an easy and obvious method of purifying hard water, by freeing it in some measure, from the unneutralised selenite, and grosser salts which it contains. The water should first be boiled for the space of fifteen or twenty minutes, then passed through the filtering stone, and afterwards suffered to stand a few hours, till it has attracted from the atmosphere a due proportion of air. Thus it will be rendered tolerably pure, salutary, and potable, and at the same time much better adapted to a variety of culinary uses. If a filtering stone cannot easily be provided, the following simple contrivance may be substituted in its room. Let a large funnel  
be

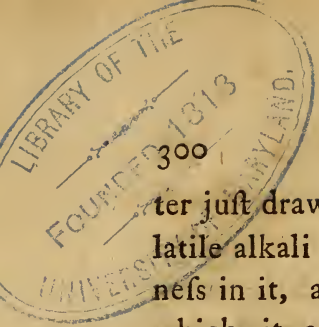
be made of wood, fill the narrow neck of it with sponge; above the sponge spread a layer of sand and gravel; cover this with a piece of thick flannel, and place over the whole another layer of sand, leaving sufficient room for the water, which is to be filtered. Care must be taken to change the sponge, sand, &c. as often as they become loaded with the impurities of the water. (*a*)

## EXPERIMENT VI.

MR. BOYLE asserts that some pump waters, barely by standing a few days, will become soft enough to mix uniformly with soap. (*b*) A quantity of hard pump water was therefore exposed to the sun and air, but so as to be sheltered from the rain, for the space of a week. It curdled with soap, and became as milky with a few drops of sugar of lead, as water

(*a*) *Vid.* Lind on the health of seamen, p. 92.

(*b*) Boyle's Works, Shaw's Edit. Vol. 1. p. 141.



## ON WATER.

ter just drawn from the well. The volatile alkali indeed, produced no cloudiness in it, and this was the only mark which it afforded of being in the least degree softened.

### EXPERIMENT VII.

A STRONG infusion of malt was not more miscible with soap, than the boiled water with which it was prepared; nor did it suffer a less precipitation on the addition of a few grains of *sacharum saturni*.

### EXPERIMENT VIII.

STRONG table beer, drawn from the barrel about ten days after it had been brewed, curdled with soap as much as the hard water boiled, which was employed in its preparation.

HENCE it appears that fermentation hath not the power of softening hard water;

ter ; and that the wholesomeness of malt liquors, must greatly depend upon the purity of the water which is used in brewing them. This coincides with the following observation of Hoffman : *Bonitas cerevisiarum primò à salubri aqua dependet. Quo salubrior aqua fontana est, eo præstantiorem exhibet cerevisiam ; & quo subtilior aqua, eo plus ingredientia extrahit, eoque melius fermentescit.* (a) As a season for brewing, the month of March is preferable to October, because the springs are then increased by the winter rains, and are proportionably softer and more salutary.

## EXPERIMENT IX.

STRONG infusions of green and bohea tea in boiled hard water, curdled with soap, and were as much changed by the addition of sugar of lead, as the boiled water itself. So that these fashionable  
and

(a) Hoffman. Op. Vol. 1. p. 113.

and favourite articles of diet, notwithstanding the soft taste which they communicate to the hardest water, do not really alter or improve its nature. It were well however, if tea could be considered in this respect merely as innocent or useless; but it imparts many pernicious qualities to its aqueous vehicle; and the daily use of it, by insensible degrees enfeebles the constitution, and brings on a train of nervous disorders.

#### EXPERIMENT X.

Two or three pieces of common brick were steeped four days, in a basin full of distilled water. The water was then decanted off, and examined by various chemical tests. It was immiscible with soap, struck a lively green with syrup of violets, was rendered slightly lactescent by the volatile alkali, and quite milky by the fixed alkali, and by a solution of *sacharum saturni*. The infusion of tormentil root produced no change in it.

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## EXPERIMENT XI.

AN experiment similar to the former was tried with a rough piece of freestone, (*saxum arenarium*) which did not appear to have communicated any impregnation to a basin full of distilled water, in which it had been several days immersed.

THE 10th experiment affords a striking proof of the impropriety of lining wells with brick, a practice very common in many places, and which cannot fail of rendering the water hard and unwholesome. Clay generally contains a variety of heterogeneous matters. The coloured loams often participate of bitumen, and the ocher of iron: Sand and calcareous earth are still more common ingredients in their composition; and the experiments of Mr. Geoffroy and Mr. Pott prove, that the earth of alum also, may in large quantity be extracted from them. Now as clay is exposed to the  
open

open air for a long space of time, is then moulded into bricks, and burnt, this process resembles in many respects that by which the alum-stone is prepared. And it is probable, that the white efflorescence, which is frequently observable on the surface of new bricks, is of an aluminous nature. (a)

IT hath long been a prevailing opinion, that water flowing through leaden pipes, acquires certain noxious qualities. Hippocrates, and his commentator Galen, expressly condemn the use of such water; and Vitruvius in his treatise on Architecture, remonstrates strongly against that means of conveying water. *Multo salubrior ex tubulis aqua quam per fistulas: quod per plumbum videtur esse ideo vitiosa, quod ex eo cerussa*

(a) THE long exposure of clay to the air, before it is moulded into bricks, the sulphureous exhalations of the pit coal used in burning it, together with the suffocating and bitumenous vapour which arises from the ignited clay itself, sufficiently account for the combination of a vitriolic acid with the earth of alum.

*cerussa nascitur : hæc autem dicitur nocens esse corporibus humanis. Itaque minimè fistulis plumbeis aqua duci videtur, si volumus eam habere salubrem. (a)* Neumann,

whose authority as a chemist is of great weight, gives it as his opinion, that the waters conveyed by pipes may corrode some of the matter of the pipe or of its cement, and thus contract disagreeable qualities. And he assures us, that having examined the aquæducts at Rome, those between Marly and Versailles in France, and those by which London is supplied with the New-river water, he found them in some places liable to this inconvenience. (b) Doctor Falconer in his ingenious and useful Treatise on the Bath waters, informs us that the leaden cistern, which serves as a reservoir for the spring at its first rise, is very much corroded on the inside, as appears by the long furrows

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which

(a) Vitruvius, lib. 8. c. 7.

(b) Neumann's Chem. by Lewis, p. 248.

which are visible in every part of it. And he, with great propriety, imputes the failure of cure, of many bowel disorders, and the obstinate costiveness so much complained of on drinking the Bath waters, in some measure to this cause. (a) Baron Van Swieten also relates, “*Vidi integram familiam hoc morbo (scilicet Colica Piætonum) laborasse, dum ad culinares usus adhibebatur aqua, in magno receptaculo plumbeo collecta, & diu hærens.*” But a celebrated writer, who has lately favoured the public with an excellent Treatise on the Poison of Lead, thinks the caution of Vitruvius and of Galen unnecessary, except in such cases where a quantity of vegetable acid might be supposed to render the metal dissoluble in water. (b) I cannot however agree with him in this opinion, notwithstanding

(a) THE waters of the Hot Bath are observed rather to open, than bind the body. The reservoir there is made of stone.

Falconer on Bath Waters, p. 184.

(b) *Vid.* Medical Transactions, No. 13.



ing his experiments at first sight appear to be so conclusive. For I apprehend the water he employed in his trials, either contained no acid, or that the acid was combined with other substances, by which it was more powerfully attracted than by lead. This metal dissolves very readily in weak *aqua fortis*, in the volatile vitriolic acid, or in oil of vitriol well diluted with water. (a) And from Dr. Cullen's table of Elective Attractions it appears, that the last of these acids has a much stronger affinity with lead, than with the earthy basis of alum. As spring waters are therefore so frequently found to be aluminous, may we not with reason suspect, that in their passage through leaden pipes, the vitriolic acid will deposit the earth with which it was combined, and dissolve some portion of the metal. And thus the fountain will become impregnated with a metallic salt, of the most

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poison-

(a) Shaw's Notes to Boerhaave's Chem. Vol. 1. p. 85.



poisonous and deleterious quality. It is a common observation that hard water renders pewter black; and this in all probability arises from a solution of the lead and tin, of which this mixed metal is composed. But as a point of so much importance to the health of mankind, ought to rest on better evidence than theoretical reasoning, the following experiment was made in order to determine, whether water impregnated with alum be capable of dissolving lead.

### EXPERIMENT XII.

Two clean and bright bits of lead, weighing 327 grains were immersed sixteen days in a phial of water, in which a drachm of alum had been previously dissolved. The volatile tincture of sulphur produced no blackness in this water, until a few drops of the solution of *sacharum saturni* were added to it, and then a dusky colour immediately succeeded. The bits  
of

of lead carefully wiped and dried, were not found to have suffered any sensible loss of weight.

THE same experiment was repeated with hard, aluminous pump water. I conceived, that the lead had communicated somewhat of a sweetish taste to the water; but when a few drops of the volatile tincture of sulphur were instilled into it, it did not exhibit any appearance of a saturnine impregnation; nor had the bits of lead lost any part of their weight.

THOUGH the result of this experiment seems to overturn the theory before advanced, yet it does not afford me full conviction, that lead is totally insoluble in aluminous waters. For the volatile tincture of sulphur may not perhaps, in every instance, be a certain criterion of the presence of this poisonous mineral, as I have proved, that green vitriol is not of

the astringency of vegetables. (*a*) Besides a proportion of lead, too inconsiderable to be detected by any chemical examination, may possibly, in irritable habits, and under certain delicate circumstances, prove highly injurious to health. (*b*) This is confirmed by the account which Doctor Tronchin has given of the Colic of Amsterdam, the cause of which long eluded the researches of the learned: At last however it was discovered to arise from the use of water, slightly impregnated with lead. But conscious of the influence of a preconceived hypothesis, I have fairly stated both the reasons and facts, relating to this point, and shall leave the decision concerning them to the more unbiassed judgment of the reader. The use of leaden pumps however may be pernicious, though the conveyance of water through pipes of this metal should  
not

(*a*) Experiments on Astringents, 2 Edit. p. 150.

(*b*) *Vid.* Dr. Falconer on Bath Waters, p. 187.

not be esteemed so: For by the friction of the bucket against the sides of the pump, some portion of lead will be rubbed off, and suspended in the water. (*a*)

(*a*) THOUGH it be foreign to my present subject, I cannot omit this opportunity of cautioning against the practice of cleaning wine bottles with leaden shot. It frequently happens, I am persuaded, through inattention, that some of the little pellets are left behind; and when wine or beer is again poured into the bottles, this mineral poison will slowly dissolve, and impregnate those vinous liquors with its deleterious qualities. The sweetness which is sometimes perceived in Red Port Wine, may arise from this cause, when such an adulteration is neither designed nor suspected.

## SECTION II.

FROM the subject of this experimental enquiry into the different properties of hard and soft water, we are naturally led to consider their influence on many of the operations of PHARMACY. And we shall find, that the most innocent vehicle, is also the most powerful *menstruum* for extracting the virtues of medicines.

## EXPERIMENT XIII.

Two drachms of green tea, were separately macerated without heat, an equal length of time, the one in three ounces of hard pump water, and the other in the same quantity of distilled water. The latter



latter infusion had a more bitter taste, and struck a much deeper black than the former, with three grains of *sal martis*..

## EXPERIMENT XIV.

A DRACHM of bark finely powdered, was macerated two days, without heat, in three ounces of distilled water; and the same quantity, during the same space of time, in three ounces of hard pump water. The infusion made with distilled water, was of a paler colour than the other, but yet tasted more intensely bitter, although somewhat less rough and styptic. Two grains of *sal martis* were added to half an ounce of each infusion, carefully filtered. The latter struck a much deeper black than the former.

DISAPPOINTED in the result of this experiment, I repeated it again, but with nearly the same success as before. Twenty drops of a strong solution of *sal martis*, produced at first no sensible change in  
half

half an ounce of the infusion made with distilled water, whilst the same number of drops, almost instantly struck an inky blackness with the other infusion, prepared with hard pump water. By degrees indeed the former assumed a dusky hue, but after standing many hours, did not half equal the blackness of the latter.

#### EXPERIMENT XV.

THIRTY drops of a solution of alum in lime water were instilled into half an ounce of the infusion of bark, made with distilled water. By this addition the same quantity of *sal martis* employed in the last experiment, immediately produced a very dusky colour; and in less than an hour, the mixture assumed an inky blackness.

#### EXPERIMENT XVI.

Two drachms of tormentil root bruised, were macerated in equal quantities,  
viz.

viz. three ounces of hard pump water, and of distilled water, during the space of twenty four hours. The latter infusion was of a deeper orange colour, than the former, and had a rougher and more styptic taste. But when twenty drops of a solution of *sal martis* were added to equal portions of each infusion, an inky blackness, to all appearance precisely the same, ensued in both.

## EXPERIMENT XVII.

AN experiment similar to the former was tried with Aleppo galls, by macerating two drachms of their powder in equal quantities of hard pump water, and of distilled water; but the result was somewhat different. I could not by comparing their tastes, determine which infusion was most astringent or styptic. The one made with distilled water was of a paler colour than the other; yet it struck a much deeper black with green vitriol.

EXPERI-

## EXPERIMENT XVIII.

EQUAL quantities of Peruvian bark powdered, were macerated without heat forty eight hours, in three ounces of hard pump water, and of the same pump water boiled. The latter infusion had a stronger taste of the *cortex*, but did not strike so deep a black with the solution of *sal martis*.

FROM these experiments it may be inferred that soft water, and especially distilled water, acts far more powerfully as a *menstruum* on vegetable bitters and astringents, than hard pump water. And the conclusion may in all probability, be extended to many other classes of vegetables. The fourteenth experiment indeed, seems at first view to prove that the Peruvian bark yields its astringency more perfectly to hard, than to soft water; but the succeeding experiment shews the fallacy of this inference. For the addition  
of



of thirty drops of a solution of alum in lime water, could not give any real increase to the strength of an infusion of the *cortex*, previously prepared; although it enabled it to strike a deeper black with green vitriol. But from this curious fact we may conclude, that hard, aluminous waters are likely to answer best in the dying of black; and this is confirmed by the observation of Dr. Lewis, that alum heightens the colour of the watery tinctures of madder and brazil. (*a*) Mr. Chambers, in his useful Dictionary, informs us, that well-water is preferred for dying red, and other colours which require astringency, and also for dying stuffs of a loose contexture, such as callico, fustian, and cotton. Doctor Ruttly also found by experiment, that hard water extracts a tincture of a deeper hue than soft water, from logwood, brazil, senna, rhubarb, and cale.

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(*a*) *Vid.* Neumann's Chem. by Lewis, p. 187.



IT is found that hard, calcareous waters render the mixture of resinous bodies, by the intervention of mucilage of gum arabic, difficult and sometimes impracticable. (*a*) This naturally led me to conceive, that soft or distilled water, might possibly dissolve those substances without the assistance of any medium, or at least with a much smaller proportion of gum, than is commonly employed. On suggesting this hint to a sensible and ingenious Apothecary of this place, he very obligingly undertook to make the experiments for me, and has sent me the following account of the result of them, which I shall deliver in his own words. The letter contains some further trials, which do not relate to the present subject; but as they lead to several useful and important conclusions, I shall without any apology insert them.

*June*

(*a*) *Vid.* Lond. Med. Observ. Vol. 1. p. 435.

June 29, 1768.

DEAR SIR,

I Have made the experiments you desired of dissolving resinous substances in distilled and common pump water, the result of which seems to be much in favour of the former.

ONE scruple of balsam of tolu, rubbed with half an ounce of distilled rain water, added gradually to it, for fifteen minutes, formed a mixture, which on standing about a minute subsided, but reunited by shaking: Being set by a few days, the balsam became a concrete mass, not again miscible by shaking up the bottle.

THE same quantity required more trituration to mix it with common pump water. The mixture was not kept.

ONE scruple of the same, rubbed with fifteen grains of gum arabic, was nearly  
as

as long in perfectly uniting with half an ounce of distilled water, as that without the gum. This was perhaps owing to the latter piece being more resinous; however, though on long standing there was a small sediment, it immediately reunited a week after by agitation.

FIFTEEN grains of balsam capivi united very smoothly with half an ounce of distilled water, by the medium of three grains of gum arabic. Five grains of the gum were not so effectual with pump water.

BALSAM Peru ten drops, with gum arabic three grains, distilled water half an ounce, formed a neat white emulsion, but with common water a very unequal mixture.

GUM myrrh powdered, that there might be no difference in the several quantities used, half a scruple, dissolved readily with gum arabic three grains, in both kinds of  
water,

water, and even mixed with them by longer trituration without any medium, but more easily with distilled than common spring water. Olibanum, mastich, gum guaiacum, and galbanum may likewise be mixed with water by rubbing, without any gum arabic or egg.

THE spring water which was made use of was from my own pump, and is very aluminous.

IN the making of all the saline preparations, when any considerable quantities of water are used, distilled or pure rain, or river water is greatly to be preferred: For the calcareous, aluminous, and felenitical matter which so much abounds in most spring water, will render any salts dissolved in it very impure. For several years before I came to reside in this town, I had prepared *Magnesia Alba*, even superior to that sold by Mr. Glas; but on attempting to make it here, I was surprised and disappointed to find it of greater specific

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cific gravity, and more coarse than usual. I was for some time unable to account for the difference, as I had conducted the process in every respect similar to my former practice; but at last discovered it to depend wholly on the variation of the water: And I always observe the Magnesia to be light and pure, *cæteris paribus*, in proportion to the purity and softness of the water I make use of. Nor will this be wondered at by any one who observes the quantity of calcareous earth and felenites, which is generally deposited by the pump water of this town, when it has been boiled and has stood some time to cool.

THE solution of crude mercury with mucilage of gum arabic being so easily accomplished, and it being very disagreeable to many patients, and to some almost impossible to swallow pills, bolusses, or electuaries; I was induced to try whether calomel, cinnabar, and the other heavy and metalline bodies commonly administered



tered only under these forms, might not by the same means be rendered miscible with water, so as to be given more agreeably in a liquid form.—I had indeed sometimes seen injections made with calomel and gum arabic, but had not observed whether it suspended the calomel so uniformly as to be given by the mouth.

I ACCORDINGLY rubbed ten grains of cinnabar of antimony and a scruple of gum arabic, with a sufficient quantity of distilled water to form a mucilage, and added a drachm of simple syrup, and three drachms more of water.

THIS makes an agreeable little draught, and having stood about half an hour without depositing any sediment, I added three drachms more of water to it, and notwithstanding the mucilage was rendered so much more dilute, very little of the cinnabar subsided, even after it had stood some days.

STEEL simply prepared, and prepared tin were both mixed with water by their own weight of gum arabic, and remained suspended, except a very small portion of each, which was not reduced to a sufficiently fine powder.

FIVE grains of calomel were mixed with two drachms of distilled water, and half a drachm of simple syrup, by means of five grains of gum arabic, which kept it sufficiently suspended: A double quantity of the gum preserved the mixture uniform still longer. In this form it will be much more easily given to children, than in syrups, conserves, &c. as a great part of it is generally wasted, in forcing those viscid vehicles into them, and it may be joined with scammony and other resinous purgatives by the same method, and of these perhaps the gum arabic would be the best corrector.

GUM arabic likewise greatly abates the disagreeable taste of the corrosive sublimate,

mate, mixed with water instead of brandy; and (from the few trials I have made) fits easier on the stomach, and will not be so apt to betray the patient by the smell of the brandy.

MR. PLENCK, who first instructed us in the method of mixing quick-silver with mucilage, observes, (and experience confirms the truth of it) that this preparation is not so apt to bring on a spitting as the *argent. viv.* mixed by any other medium, or as the saline and other mercurial preparations.—How far the theory by which he accounts for it may be just, is not of much importance, but it may perhaps be worth while to enquire whether it would not be equally effectual in preventing calomel, and the other preparations of mercury, from affecting the mouth.—If so, is it not improper where a salivation is intended, to give emulsions with gum arabic and other mucilaginous liquors for the patient's common drink, as by that means the spitting may be re-

tarded? And on the contrary, may it not be a useful medicine to diminish the discharge when too copious? (a)

BUT — *Ne futor ultra crepidam.* And though I am sure your friendly candour will excuse these trifling observations, which have occurred as I was writing, yet I fear I trespass upon time which you would

(a) THE following case may in some measure serve to confirm the above observation.

A GENTLEMAN, always easily affected by mercurials, having taken about twenty-six grains of calomel in doses from one to three grains, notwithstanding he was purged every third day, was suddenly seized with a salivation. He spat plentifully, his breath was very foetid, teeth loose, and his gums, fauces, and the margin of his tongue greatly ulcerated and inflamed. He was directed to use the following gargle.

R. *Gum. arab. semiunc. solve in aquæ font. bullient-selib.*  
 & *adde mel. rosac. unc. unam. M. ft. gargar.*

AND to drink freely of a ptisan prepared with *aq. bord. lib. ij. gum. arabic. unc. ij. nitr. pur. drachm. ij. sacchar. alb. unc. j.*

His purgative was repeated the succeeding morning.

THE

would spend much more usefully, than in perusing these indigested thoughts of, dear Sir,

*Your very obliged and humble Servant,*

THOMAS HENRY.

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EXPERI-

THE next day his gums were less inflamed; but the sloughs on his tongue, &c. were still as foul; his spitting was much the same: he had drank about a pint of the ptisan.—Some *spt. vitrioli* was added to the gargle.

FROM this day to the fourth, he was purged every day without effect—his salivation still continued, his mouth was no better—he had neglected the mucilaginous drink—this evening he was persuaded to drink about a pint of it which remained, and he had it repeated, and drank very freely of it that night.

ON the fifth morning the purgative was again repeated. Though it operated very little, yet the change was very surprising, his mouth was nearly well, and his ptyalism greatly decreased—the ptisan was repeated, and on the sixth day being quite well, he was permitted to go abroad.

SEE also Dr. Saunders's appendix to the second edition of Mr. Plenck's Treatise, since published.



## EXPERIMENT XIX.

IT has been remarked by Professor Whytt, and many others, that different kinds of quick-lime impregnate water with different degrees of strength. This suggested to me that a diversity in the *menstruum*, may also considerably vary the qualities of the lime-water. And my conjecture has been confirmed by the ensuing experiments.

EQUAL quantities, viz. a quart, of distilled water, of boiled pump water grown cold, and of the same hard pump water unboiled, were severally added to half a pound of quick-lime. After an infusion of twenty-four hours, the waters were decanted off, and filtered through paper. Ten drops of syrup of violets struck a deep green with the lime water made with distilled water, a lighter one with that prepared with boiled water, and the lightest with the raw pump water. Sixty drops

drops of a solution of salt of tartar in distilled water, added to each lime water in the foregoing order, occasioned the largest precipitation from the first, the next in degree from the second, and the least from the third. The tastes of the different lime waters corresponded also with the above-mentioned tests. For that made with distilled water was by far the most pungent, and yet the least disagreeable; whereas that prepared with raw pump water, was extremely harsh and nauseous, without being proportionably impregnated with the acrimony of the quick-lime.

## EXPERIMENT XX.

THREE fragments of human *calculi*, numbered for the sake of distinction, 1, 2, 3, were immersed in equal quantities of different lime waters; the first in lime water made with distilled water, the second in lime water prepared with hard pump water, and the third in lime water  
made

made with the same hard pump water poured boiling hot upon the quick-lime. No. 1, was of a brown colour and hard texture, was smooth on one side and rough on the other, and weighed twenty-six grains and a half. No. 2, was a fragment of the same *calculus*, and weighed twenty five grains and a half. No. 3, a fragment of a different *calculus*, was of a looser and more spongy texture than the former, and weighed twenty-seven grains. The phials which contained the *calculi* and four ounces by measure of lime water, were all nearly full, and closely corked up. After continuing the maceration eight days without heat, the *calculi* were taken out, carefully dried on filtering paper before a gentle fire, and then weighed. No. 1, had lost a grain and a half, and was covered over in many parts of it with a soft, white, cretaceous matter. No. 2, had lost only half a grain: Many little crystals shot from its surface. No. 3, had lost a grain. But it should be remembered, that this fragment was much softer

softer than the other two. The lime employed in this experiment was common stone quick-lime ; that used in the former experiment, was brought out of Derbyshire, and made of a species of marble containing a great many shells in its substance. I was not aware of the difference of the lime, till after my trials were compleated.

THESE two experiments, I think, satisfactorily prove, that soft water is a much more powerful dissolvent of quick-lime, than hard water, (*a*) at the same time that it covers and meliorates the harsh taste of that acrid substance. Where distilled water cannot conveniently be provided, rain water, freed by filtration from

(*a*) To ascertain more fully this important point, I have since repeated the experiment above recited, by immersing again the fragments of the same calculus, Nos. 1 and 2, in equal quantities of fresh lime water, prepared with distilled water, and with hard pump water. In twelve days, No. 1, was entirely reduced to a chalky powder, whilst No. 2, preserved its texture, to all appearance unchanged.



from its impurities, may with equal efficacy be substituted in its room. Had a different kind of lime been employed in the last experiment, or had the digestion been made in a sand bath, it is probable the solvent power of each *menstruum* would have been increased. The little pointed crystallizations, which were observed to shoot from the fragment of the *calculus* No. 2, remind me of a similar appearance which occurred in one of the trials of the late Dr. Whytt, and which he informs us surprised him greatly. He ascribes them to the sea salt adhering, even after calcination, to the oyster-shells which he employed. (a) But the Doctor must have been mistaken in his explanation, as in the experiment just recited, common stone quick-lime alone was used, which cannot be supposed to contain any sea salt. And the crystallizations were perceived only in that phial of lime water, which had been prepared with hard pump water.

(a) Whytt's Essay on Lime Water, 3d Edit. p. 74.



## SECTION III.

A COMPARATIVE VIEW OF THE DIFFERENT PROPERTIES OF SNOW WATER, RAIN WATER, SPRING WATER, &c.

SNOW WATER is said by Mr. Boyle to be the lightest of all waters; and if received upon the tops of high mountains must, one should conceive, be free from all foreign impregnation. And yet the same accurate chemist found on examination, that it is not entirely destitute of saltiness. But notwithstanding the superior purity of snow water, I should apprehend, that it is not the most wholesome liquor for common drink, both from its extreme coldness, and because its properties as a *menstruum* are changed by the congelation it hath undergone. For freez-  
ing

ing decomposes water, by separating from it a considerable portion of air. And that this alters its qualities is evident from the following facts. 1. Water when fresh, dissolves a larger quantity of salt, than when exhausted of its air. 2. Water saturated with any salt, when placed *in vacuo* under the receiver of an air pump, will deposit part of its solvend. 3. Snow water is observed not to boil greens or pease so well as common water. 4. The nitrous acid generates a much less degree of heat with snow water, than with common water. 5. Snow, mixed in a certain proportion with flour will, like eggs, render it when baked or boiled, perfectly light and adhesive. Hippocrates utterly condemns the use of snow or ice water, because after congelation it never re-assumes its former nature; the clear, light, and sweet part of it being dissipated, whilst the most turbid and heavy is left behind. And he adduces an experiment in support of this reasoning. Expose, says he, a vessel containing a certain quantity

tity of water to the cold air in winter time, so as that it may be frozen hard; then bring it into a warm place, where it may thaw; and when the ice is dissolved, measure the water again and you will find it evidently diminished. But this loss of bulk is not as Hippocrates supposes, to be ascribed to the dissipation of the thinner and finer parts of the water by congelation, but chiefly to the separation of the air which it contained; and therefore his reason for condemning the use of snow water is founded on a false hypothesis. This however does not invalidate his objection to it, which at first, in all probability, he deduced from experience, and afterwards attempted to explain and confirm, by what now appears to be mistaken theory.

THE fertilizing effect of snow on the ground is universally known, and may in part arise from the covering which it affords to the earth, by which the ascent of vapours is repressed, and a fermentation promoted

promoted in the soil. But I apprehend it depends not less upon the snow being destitute of air, so that like lime, when dissolved and sunk into the earth, it abstracts air from the soil, occasions an intestine motion in its particles, and thus pulverises them.

ICE WATER: What has been said of snow water is equally applicable to ice water, except that its specific gravity is greater, and that it is less free from saline impregnation, and consequently still less salubrious.

RAIN WATER, when collected in clean vessels, at a distance from large towns, is light, soft, and wholesome. But as it passes through the atmosphere, which is a chaos of different exhalations from the animal, vegetable, and mineral kingdoms, it must wash down some of those floating, volatile particles, and be impregnated with them. Hence rain will differ in some slight degree, according



ing to the season of the year, as well as the country in which it falls. That it contains a quantity of adventitious matter is evident from the curious experiments of M. Margraaf, from its tendency to putrefy, from the green weed which springs up on its surface, and from the mucilaginous or ropy substance which grows copiously on it, and which Boerhaave compares, on viewing it through a microscope, to a grove of little mushrooms. It is observed also, after standing a while, to be full of the *ovula* of different animalcules; some of which may have been carried down with it, in its passage through the air, but the greater number are probably deposited in it, during its stagnation. But although these circumstances prove, that rain water is by no means an homogeneous fluid, or free from impurity, yet it is universally acknowledged to be the most salutary of all other kinds of water. And by percolation through sand or stone, or by boiling and decanting, its foulness would in

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a great measure be separated, and it would be rendered a grateful, potable, and very wholesome liquor. Its levity is so great, that distilled rain water is not lighter than the natural, as Boerhaave affirms after weighing them in the hydrostatical balance. Nor need we wonder at this, as the exhalation of aqueous vapours from the earth and sea, is exactly analogous to distillation; if it be not an impropriety to compare the vast and stupendous operations of nature, with the trifling efforts of art. Hippocrates gives his testimony in favour of rain water, but directs that it should be boiled or strained; otherwise it has an ill smell, and occasions a hoarseness, and deep voice in those who drink it. (a)

SPRING WATER: This must vary in its properties according to the nature of the soil, and different strata of earth, through which it passes. The purest is  
that

(a) Hippoc. *de Aere, Aquis et Locis.*

that which flows, at no great depth, through a light gravel, or sand. Dr. Hales mentions several springs remarkable for their levity, and freedom from calcareous impregnation. The water, conveyed by pipes to Hodson in Hertfordshire, which rises from a gravel, and gushes out of a fine white sand, he informs us, left no incrustation in a boiler, which had been used fifteen years. And that of Comb in Surrey, a hill the soil of which is gravel almost to the surface, is also uncommonly light, soft and free from all adventitious ingredients. As the springs issue from the brow of the hill, out of the gravel, the Doctor justly observes, that the water must partake greatly of the nature of rain water; since the dew and rain which fall on that hill, receive probably no other alteration from percolating through the gravel, than that of being rendered more pure and free from foulness. (a) Hippocrates lays a

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(a) *Vid.* Statical Essays, Vol. 2. p. 242.

great stress upon the choice of springs, which have an eastern aspect. Such waters, he says, are chiefly to be commended, that gush out towards the rising of the sun; because they are clearer, lighter, and of a better smell than others. But I apprehend there is no foundation for this opinion: For water which flows through clay, marle, black mould, or beds of minerals, will be equally hard and unwholesome in whatever exposure it first bursts out. The purity and salubrity of it may however, with sufficient accuracy be ascertained, by its levity, transparency, and perfect insipidity; by its mingling uniformly with soap, and boiling pulse tender. And these are common tests, which it is in the power of every one to apply.

RIVER WATER: This is generally much softer, and better adapted to economical uses than most spring water. For though rivers proceed originally from springs,

f springs, yet by their rapid motion, (*a*) and by being exposed during a long course, to the influence of the sun and air, the earthy and metallic salts which they contain are in part decomposed, the volatile acid flies off, and the terrestrial or ochery particles with which it was combined, become insoluble and are precipitated. To this it may be added, that rivers are also rendered softer by the vast quantity of rain water, which passing along the surface of the earth, is immediately conveyed into their channels. But all rivers carry with them, a great deal of mud, filth, and other impurities. And when they flow near large, populous, and manufacturing towns, they become the receptacles of all the common sewers, and are impregnated with an heterogene-

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ous

(*a*) THE Rhine and the Rhone, which flow from the Alps, whilst they preserve the rapidity of their course, are observed to be light and pure. The difference betwixt the Rhine and the Maine, is obvious to those who navigate these rivers: For the barges which sail from the latter into the former, sink considerably deeper in the one, than in the other.

ous mixture of coperas, alum, soap lyes, logwood, and the refuse of a thousand other substances, employed in different arts. In this state, river water is certainly unfit for the common purposes of life. And yet if it be suffered to remain a while at rest, all the feculencies will subside, and the water will become sufficiently pure, grateful, and potable.

STAGNANT WATERS: These of all others are the most impure and insalubrious. Hippocrates asserts that they enlarge and obstruct the spleen; and his observation is almost daily confirmed, by the dissection of those who die of the scurvy; a disease which putrid, stagnant water hath a powerful tendency to produce. Dr. Hoffman, by means of a glass waterpoise divided by lines, examined hydrostatically several different kinds of water. Rain water he found to be the lightest; river water was one line heavier; the water commonly used at Hall, in Saxony, was heavier by two lines; the spring water of the  
same



same place was four lines heavier; that of a particular spring was six lines heavier; and water which had been long kept in an open vessel, in a cellar, was six lines and a half; but stagnant water, drawn out of the town ditch at Hall, was seven lines heavier than rain water. (a)

I SHALL conclude this Essay with the following observations of Celsus, which in many respects coincide with what has been advanced. *Aqua levissima pluvialis est; deinde fontana, tum ex flumine, tum ex puteo; post hæc ex nive aut glacie; gravior his ex lacu; gravissima ex palude. Facilis etiam et necessaria cognitio est naturam ejus requirentibus. Nam levis pondere apparet, & ex his quæ pondere pares sunt, eo melior quæque est, quo celerius et calefit & frigescit, quoque celerius ex ea legumina percoquuntur.* (b)

(a) Vid. Hoffman Obs. Chem. p. 140.

(b) Celsus Lib. 2. Cap. 18.

A REVIEW OF THE PRINCIPAL FACTS  
ASCERTAINED BY THE PRECEDING  
EXPERIMENTS.

1. **T**HE Manchester pump water is in general very hard and impure. It is impregnated with a large quantity of felenite, and contains also no inconsiderable proportion of alum.

2. THE hardest water will become soft and miscible with soap, by the addition of salt of tartar. But such a quantity of the vegetable alkali is required, to produce this effect on the Manchester pump water, as renders it offensive to the palate, and unfit for common use.

3. HARD water is considerably softened by boiling. For though heat generally increases the dissolving power of any  
*menstruum,*

*menstruum*, at the same time it tends, in many instances, to destroy the texture, and disunite the component parts of the solvend. Thus the grosser salts contained in hard water are decomposed by the boiling heat; the volatile vitriolic or muriatic acids fly off, leaving behind them an indissoluble, petrefying earth, which subsides to the bottom, and incrusts the vessel. But the coction should be continued fifteen or twenty minutes, to produce its full effect. The water should then be suffered to remain a few hours exposed to the atmosphere, to recover its due proportion of air before it be used. For the loss of this air by boiling, alters the properties of water, and probably may render it less salutary.

4. HARD water is softened by being filtered through stone. And if it were first boiled a sufficient length of time, and then filtered, it would be rendered tolerably pure, potable, and salutary, and at  
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the same time much better adapted to a variety of culinary uses.

5. MR. BOYLE asserts, that some pump waters, by exposure to the sun and air for a few days, will become soft enough to be miscible with soap. But this is not the case with the hard water of Manchester.

6. NEITHER malt nor tea produce any softening effect, on the hard water in which they are infused. Nor does fermentation improve or alter its nature. So that the wholesomeness of malt liquors, must greatly depend upon the purity of the water, which is employed in their preparation.

7. BRICKS harden the softest water, and give it an aluminous impregnation. The practice of lining wells with them, which is common in many places, is therefore very improper. Free-stone communicates no pernicious qualities to water.

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8. THOUGH by the tables of elective attractions it appears, that the acid of vitriol hath a stronger affinity to lead, than to the earth of alum, yet this metal does not appear by experiment, to be soluble in aluminous waters. But perhaps the volatile tincture of sulphur may not, in every instance, be a certain criterion of the presence of lead, as green vitriol is not of the astringency of vegetables. And a proportion of this poisonous mineral, too minute to be discovered by any chemical examination, may in irritable habits, and under certain delicate circumstances, prove highly injurious to health.

9. SOFT water, and especially distilled water, acts far more powerfully as a *menstruum* on vegetable bitters and astringents, than hard pump water. And it dissolves resinous bodies without any medium, or at least with a much smaller proportion of mucilage of gum arabic, than is commonly employed.

10. HARD,



10. HARD, aluminous waters are likely to succeed best in the dying of black, red, and other colours, which require astringency, and also in the preparation of ink.

11. SOFT water is a much more powerful dissolvent of quick-lime, than hard water; at the same time that it covers and improves the harsh taste of that acrid substance. The fragment of a human *calculus* was entirely reduced to a chalky powder, by being immersed twelve days in lime-water, prepared with distilled water; whereas another fragment of the same *calculus* suffered no visible change in its texture, by being macerated an equal length of time in lime-water, made with common pump water.

12. IN nephritic cases, distilled water would be a good substitute for Malvern-water; for it is a powerful solvent of the human *calculus*.

ON THE  
DISADVANTAGES  
OF  
INOCULATING CHILDREN  
IN  
EARLY INFANCY.

THE SECOND EDITION, REVISED AND ENLARGED.

*Non quæ mihi suggessit phantasiæ imagina-  
tricis temeritas, sed quæ phnæomena prac-  
tica edocuere.*

SYDENHAM.

ON THE  
DISADVANTAGES  
OF  
INOCULATING CHILDREN IN  
EARLY INFANCY.

**T**HE advantages arising from inoculation are now so universally acknowledged, that arguments in support of it seem to be entirely unnecessary. The rapid progress it hath made, affords the strongest presumption in favour of its safety and utility; and the well-attested accounts which we every day read, of the success with which it is practised, justly remove every prejudice against it, whether political or religious. The patrons of inoculation therefore, have nothing to fear from its avowed enemies, if

if any such there be ; but they have the utmost reason to guard against the mistaken zeal of its friends, which may prove perhaps more dangerous to its real interest, than opposition itself. Credulity, fashion, the love of novelty, and a propensity to rush from one extreme to another, are principles which have too much influence on the generality of mankind. And how unfavourable these have been to the advancement and perpetuity of improvements, might be demonstrated by numerous examples. That the artificial method of communicating the small-pox, so happily introduced amongst us, may not hereafter be added to this disgraceful list, every sincere advocate for it, should exert his warmest endeavours to discourage the wanton levity, with which it is at present in many places adopted. For the indiscriminate use of remedies, excess in the cooling regimen, and a total disregard to age, temperament, and habit of body, cannot fail in the issue to injure the reputation, and check the progress of one  
of



of the most important discoveries in the whole circle of phyfic.

IN the third volume of the MEDICAL OBSERVATIONS and INQUIRIES, Doctor MATY, a learned and ingenious Physician in London, hath inserted an Essay on the advantages of very early inoculation. He proposes that people should be induced by persuasion, and by other encouragements if necessary, to inoculate their children as soon as possible after their birth. And this he considers as the *maximum*, to which the art of inoculation can be brought, both with respect to individuals, and to the public. But the Doctor's reasoning in support of his hypothesis, appears to me to be more ingenious and plausible, than solid and satisfactory. And I apprehend the practice which he recommends, would considerably diminish the benefits arising from inoculation, and would be of dangerous and fatal consequence to mankind. I shall endeavour therefore to point out the

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disadvantages which would attend the ingraftment of the small-pox on new-born children ; and shall also make some strictures on Dr. MATY's arguments in favour of it.

1. THE number of diseases to which infants are incident, render them unfit subjects for inoculation. HIPPOCRATES, two thousand years ago remarked, *Ætatibus morbosissimi sunt juniores*. And when we consider the great and sudden changes, both external and internal, which they undergo at birth ; the laxity and wonderful delicacy of their frame, and their extreme irritability perhaps depending upon it ; the copiousness of the glandular secretions, with the difficulty of preserving that equilibrium, the least deviation from which affects them ; it is matter of real astonishment, that life itself can be supported, under a series of such apparently unfavourable circumstances. Scarcely hath the little stranger been ushered into the world, but he discovers signs of indisposition,

indisposition, by his restlessness, anxiety, crying, and vomiting, by the swelling of his belly, and sometimes by convulsions. These symptoms arise from the load of *meconium* with which the stomach and bowels are oppressed, and generally cease when those organs have been gently evacuated. The jaundice next succeeds, and is sometimes complicated with a very acrimonious state of the fluids, as appears by the eruption of little red pustules, with which the skin is every where loaded. The thrush, watery gripes, and convulsions observe no regular order of time, but attack most infants, either singly or collectively, according as they are more or less obnoxious to the causes which produce them. The quick growth of children in the first period after birth, is likewise a source of numerous ailments; notwithstanding the provision which nature hath made, to guard against the inconveniences resulting from it, by the laxity of the glandular system. The sudden enlargement of the fœtus, in the

womb of the mother is truly surprising. Dr. HARVEY relates, that in the deer kind, he observed the *punctum saliens*, on the 19th or 20th of November. On the 21st he saw the *vermiculus* or embryo of the animal; and on the 27th the fœtus was so perfect, that the male might be distinguished from the female, the feet were formed, and the hoofs were cloven. This rapid growth must be ascribed to the soft and yielding structure of the fœtus, to the plenty of nutrition it receives, to its exemption from all discharges, and to the proportionably strong action of its little heart. And as most of these causes continue to exert their influence after birth, though in a less degree, the increment of the young animal proceeds apace, and redundancies are formed, which in a healthy state are carried off by one or other of the glandular excretions. But a deficiency or excess in any of these, necessarily produce diseases. And in such feeble, delicate, and irritable subjects, the equilibrium cannot long be preserved. If they  
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are defective, all the complaints which arise from plenitude ensue; the child grows feverish, dull, and comatose; his stomach is disordered, his bowels are oppressed with wind, and if his belly be constipated he falls into convulsions. On the other hand, if they are excessive, a *diarrhœa* is produced, *aphthæ* and severe gripes succeed, and the violent irritation seldom fails to occasion epileptic fits. From this short view of the first period of infancy, I think it must appear evident, that inoculation is ill adapted to that tender season of life. Nature, feeble and irritable as she then is, can scarcely struggle with the diseases to which she is ordinarily exposed. It is therefore equally cruel and unjust to add to the number with which she is already oppressed. For it is demonstrable from the bills of mortality, that two thirds of all who are born, live not to be two years old; and I think it is more than probable, that a considerable proportion of these, die under the age of six weeks.



2. THE fears and anxiety of the mother, excited at a time when her strength hath been exhausted by the pains of labour, and when every uneasy impression should be cautiously avoided, cannot fail to injure her milk. And this is a powerful objection to the early ingraftment of infants. If a hired nurse be employed, her milk may disagree with the child, she may fall into some disease during the time of inoculation, may be guilty of excess in eating or drinking, or may be under the influence of violent passions; each of which will aggravate the symptoms, and increase the danger of the artificial distemper, under which the infant labours. (a)

3. IT

(a) INFANTES ex assumpto lacte nutricis, quæ brevi ante ira vel terrore perculsa fuit, in gravissima pathemata, convulsiva, epileptica, & sævissima alvi tormina incident.

Hoffman. Op. Vol. 1. p. 196.

A CHILD, whose mother was its nurse, became feverish on the third day of eruption, which caused violent anxiety in the mother, a rash with costive belly, was then observed, and the child died on the second day after it.

Monro's Acct. of Inoc. in Scot. p. 25.

A NURSE

3. IT hath been observed by a very able and experienced practitioner, (*a*) that young children have usually a larger share of pustules from inoculation, than those who are a little farther advanced in life : And that from this circumstance so many have died, as to discourage the practice of ingrafting the small pox on such delicate subjects. This fact is not easy to be explained. Whether the greater irritability of infants subjects them to be more affected with the variolous *miasma*, than children of two or three years old ; or whether the larger eruption, to which they are liable, be owing to the proportionably greater quantity of their fluids,

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A NURSE of an inoculated child who died, was discovered to have drank immoderately of malt liquor, during the process of inoculation.

Monro's Acc. of Inoc. in Scot. p. 33.

THE nurse of an inoculated child who died, was suspected to have been tainted with the Lues venerea, by her husband, who was afterwards discovered to have had the disease, and at the time she was nursing the child.

Monro's Acc. of Inoc. in Scot. p. 33.

(*a*) BARON DIMSDALE.

I will not presume to determine. Both causes may possibly conspire to produce this effect; the former by exciting a quicker, and increased contraction of the heart and vascular system; the latter by affording a more copious *pabulum* for the variolous ferment. By the same principles we may perhaps account for the greater virulence of the *lues venerea*, in infancy, than in the more advanced stages of life.

4. A CONSIDERABLE number of those who die of the natural disease, before the expulsion of the variolous eruption, are infants or very young children. (a) This does not arise, as Dr. KIRKPATRICK supposes, from the extreme weakness of the *vis vitæ* of infants; for the contraction of their hearts is proportionably stronger than in adults, as the quickness of their growth evinces; but from the high degree of irritability with which their nervous

VOUS

(a) KIRKPATRICK's Analysis.

vous system is endued. Hence the convulsive paroxysms, which often precede the appearance of the pustules, and which, though regarded by SYDENHAM as no unfavourable signs, are always alarming, and when they happen to very young infants, are frequently fatal.

5. IF such a number of pustules should break out in the mouth or throat as to obstruct suction, the disease, in all probability, would prove fatal. Even a few pocks in those parts are highly troublesome and dangerous to infants; for besides the pain and restlessness which they produce, they often terminate in ill conditioned ulcers. *(a)*

6. THOSE who are affected with cutaneous diseases, have been generally regarded as unfavourable subjects of inoculation. *(b)* Infancy, therefore, which is seldom unattended with eruptions on the skin,

*(a)* Vid. SCHULTS on Inoculation.

*(b)* DR. JURIN's Account of Inoculation.



skin, must be an improper period for receiving the small pox by ingraftment.

7. THE thickness of the teguments of infants, which arises from the quantity of fluids interposed between their fibres, by which the skin is rendered soft and œdematous to the touch, and their perspiring less than children who are capable of using exercise, are further objections to very early inoculation.

8. BUT the most forcible argument against this practice, is deduced from the ill-success which hath attended infant inoculation in general. For it appears by Dr. JURINS' account of the progress of inoculation in Great-Britain from 1721 to 1726, and by Dr. SCHEUCHZER's continuation of it to 1728, that of fifty eight children under two years old, who received the small-pox by ingraftment, six died; whereas of two hundred and twenty one, inoculated between the ages of two and five, only three died.

HAVING



HAVING thus pointed out some of the principal objections to the early inoculation of infants, I shall make a few remarks on Dr. MATY's ingenious Essay in favour of it. After enumerating the advantages which infancy has with regard to the small-pox, the Doctor sums up the whole by saying: "If there is a period  
 " in which the machine is in a perfect  
 " state, it certainly is immediately before  
 " it begins to be spoiled, or at the first  
 " period after nativity." (*a*) This assertion, I apprehend, is repugnant to reason, anatomy, and experience. It seems to be a general law of nature, that all organised bodies should advance by progressive stages to their acme or state of perfection; and should then decline by the same regular gradation. A plant when it first springs out of the ground is frail and tender, by degrees the stem thickens, the leaves expand themselves, the juices are concocted, the flower opens, the seed is formed, ripened, and shed;  
 and

(*a*) Medical Observations, Vol. 3. p. 290.

and when the office assigned it by the sovereign Creator is thus accomplished, it droops, withers, and falls into decay. The animal world furnishes still more striking proofs of the truth of this observation. And I know nothing which contributes more to the beauty and harmony of the universe, or affords a more admirable display of the wisdom of its great Author, than the order and uniformity with which these successive changes are carried on, amongst the different classes of beings.

FROM the researches of anatomists into the structure of the human body, it is evident that our machine in infancy is comparatively extremely imperfect, that its parts are disproportioned, and its organs incapable of those functions, which they are destined in future life to perform. The head of a new-born child, bears a much larger proportion to the bulk of his body, than that of an adult; the former being as one to three, the latter only as  
one

one to eight. And this joined to the remarkable laxity of the fibres in infancy, is the reason perhaps of the excessive irritability with which the body is then endued, and which lays a foundation for numerous diseases. The Liver and Pancreas are so immensely distended, as to fill up almost the whole cavity of the abdomen; and the copiousness of their secretions is equal to their bulk. The bile, cystic and hepatic, is almost insipid, and so inert that it is incapable either of promoting digestion, or of neutralizing those acidities, which the weakness of the stomachs, and the acescency of the food of infants, generate in the *primæ viæ*. Hence probably arise the crudities, flatulency, gripes, aphthæ, and convulsions, to which children, at that tender age, are peculiarly exposed. The heart, with respect to the vascular system, is both stronger and more bulky in infancy than in after life. (a) By this means the blood is propelled

(a) By the curious tables of Dr. BRYAN ROBINSON, it appears, that the weight of the heart with respect to the weight

pelled with greater force; and as the arteries at that period have less firmness and density than the veins, as appears by Sir CLIFTON WINTRINGHAM's experiments, they are then most yielding and distensible. And both these causes equally conspire to promote and quicken the growth of the young animal. But wise and necessary as this provision of nature is, it unavoidably exposes the infant to all the dangers which arise from a plethora, and must be considered as a present imperfection, however well adapted it may be to those progressive changes, which advance him from childhood to maturity. For by degrees the heart abates of its proportional force, and the arteries acquire their greatest amplitude. At this period the  
moving

weight of the body, is greater in a child than in a man, in the proportion of three to two: that the quantity of blood which flows through the heart in a given time is greater in children than in grown bodies, in the proportion of twenty to seven, which is the proportion of their pulses in a minute: and that the velocity of the blood is greater in a child than a man, in the proportion of eighty to seven.



moving powers of the machine are equally balanced, and the body seems to enjoy for a while a state of rest. But the delicate equilibrium cannot long be maintained: The heart grows feeble and languid, the arteries gradually contract themselves, a venous plenitude ensues, and old age closes the scene.

BUT analogy may deceive us, and the observations of anatomists may be doubtful; experience however carries conviction along with it, and incontestibly demonstrates, that the human body, contrary to the assertion of Dr. MATY, is most imperfect in the first period after nativity. For it is universally acknowledged, that infancy is liable to a much greater variety of maladies than any other stage of life. This can arise only from the extreme delicacy of the structure, and disproportion of the parts of new-born children; and both the cause and effect, in this instance, are marks of frailty and imperfection.

“ CONVUL-



“ CONVULSIONS in young babes, says  
“ Dr. MATY, seem to be, not so much  
“ a disease, as an indication of some dis-  
“ order in the bowels, or the effort of  
“ nature to expel some enemy.” (*a*) The  
observation is in general just, for I believe  
the true idiopathic convulsions happen  
very rarely. But though somewhat less  
alarming on this account, these fits are  
always attended, in such feeble and deli-  
cate subjects with imminent danger.  
Many it is well known have expired un-  
der them ; while others, who have strug-  
gled through with great difficulty, have  
been so debilitated, and their faculties so  
impaired, that the effects have been per-  
ceptible during the remaining part of their  
lives. (*b*) The convulsions about the  
time of the eruption, and subsiding of the  
inoculated small-pox, says Dr. Monro,  
are the most frequent bad symptom in this  
disease ; and by them more of those in  
the

(*a*) Medical Observations, Vol. 3. p. 292.

(*b*) DIMSDALE on Inoculation.

the column of dead, lost their lives, than by any other cause. (*a*)

“ THAT disposition in the intestinal tube to excoriate, which arises from the too great acescency of milk or vegetable aliments, is easily corrected by magnesia, lime-water, oil, and by small quantities of broth or other animal food.” (*b*) The remedies which Dr. MATY hath here pointed out, are very judicious and proper; but their effects are much more uncertain than he seems to apprehend. The ailments of children are generally very complicated, and the indications of cure are often obscure and doubtful. In their irritable bodies, one symptom frequently brings on a variety of others, sometimes connected with the original one, at other times, to all appearance totally dissimilar. And these symptoms of symptoms,

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(*a*) *Monro's Account of Inoculation in Scotland*, p. 25.

(*b*) *Medical Observations*, Vol. 3. p. 293.

as they are termed, do not always cease, when the cause which first produced them is removed. This every physician experiences, who is conversant with the diseases of infants; and it necessarily occasions, in his treatment of them, some degree of difficulty and confusion.

FROM the lists of Dr. JURIN, and Dr. SCHEUCHZER, Dr. MATY finds that nine out of two hundred and seventy-three, i. e. one out of thirty, inoculated under five years of age, died between the years 1721, and 1728. But if the doctor had confined himself, as he ought to have done, to the list of those who died by inoculation under one year old, he would have found the proportion to be vastly greater, viz. no less than one in twelve. But as even one in thirty is a great mortality, and as the operation in grown people, during that period, appears to have carried off only one in fifty; Dr. M. endeavours to obviate this objection in the following manner: “As so  
“many

“ many more children under five years,  
“ die of different disorders, than at any  
“ other age, it is more than probable  
“ that several, perhaps most of these  
“ nine would have died, though they  
“ had not been inoculated.” (*a*) But  
though the Doctor has given some good  
reasons for presuming upon this probability,  
I would ask him where is the justice  
or propriety of ingrafting the small-pox  
at a period when, from the instances he  
himself adduces, the risque appears to be  
so great of other dangerous, and fatal  
distempers acceding to it? For slightly  
as this artificial disease is now regarded,  
it is of itself sufficient for the powers of  
nature to struggle with in early infancy.

THE second part of Dr. MATY's essay,  
displays the political advantages, which  
would accrue from the early inoculation  
of infants. But if it be evident from what  
has been advanced, that the practice he

B b 2

recom-

(*a*) Medical Observations, Vol. 3. p. 295.



recommends, is prejudicial to individuals, it will require no arguments to prove that it must be equally so to the public. The absurd custom of separating, in the bills of mortality, the ages of those who die, from the diseases by which they are carried off, renders it impossible to ascertain with precision, the risque of the natural small-pox, which is incurred by delaying inoculation. But from my own experience, as well as from the observations of the most intelligent of my medical friends, I should conclude this risque to be very trifling; and that the small-pox is a distemper to which children, in the first period of life, are rarely liable. For at that tender age they are neither in the way of infection, nor are they much disposed to receive it. Dr. Monro informs us, that of twelve infants, inoculated within a fortnight after their birth, not one had the variolous eruption. (a)

To

(a) Monro on Inoculation, p. 25.



To conclude : Though infants are less proper subjects for receiving the small-pox by ingraftment, than children a little further advanced in life, yet it must be confessed, that such circumstances may occur, as to render the inoculation of them highly expedient and adviseable. In such cases however, I think the age of two or three months, is preferable to the period which Dr. MATY recommends. For it will then be too early to apprehend any disturbance from dentition; and yet the child will have surmounted some of the diseases, peculiar to the first stage of its existence. The chylopoietic organs will also by that time have been so strengthened by exercise and habit, as to discharge their functions with some degree of regularity. But the fittest season for inoculation seems to be, between the age of two and four in healthy children, and of three and six in those who are extremely tender and delicate. The powers of nature are then sufficiently vigorous; perspiration is free

and copious ; the irritability of the body is greatly diminished ; the viscera are found and unobstructed ; the mind though active and lively, is not disturbed by violent emotions ; the teguments are properly extenuated ; and the fibres are neither too tense, nor too lax for the variculous eruption. To these important advantages may be added, that at this age the child is both a proper subject for preparatory medicines, and for such as may be deemed necessary during the course of the distemper. It is no wonder therefore, that the practice of inoculation is attended with most success at this period. And it is seriously to be lamented, that the precious opportunity should ever be neglected.

ON THE

E F F I C A C Y

OF

EXTERNAL APPLICATIONS

IN THE

ULCEROUS SORE THROAT.

*Ad utilitatem Vitæ omnia consilia factaq;  
nostra dirigenda sunt.*

TACITUS.

ON THE EFFICACY OF  
EXTERNAL APPLICATIONS  
IN THE  
ANGINA MALIGNA,  
OR,  
ULCEROUS SORE THROAT.

THE ANGINA MALIGNA is for the most part so rapid in its progress, that it requires all the assistance of art to counteract its malignity, and to prevent its fatal termination: And when children are attacked with it, we are often reduced to the most distressing perplexity from the difficulty of persuading, or the danger and impossibility of forcing them to use those means which are necessary for their relief. It has been my misfortune lately to attend several such froward patients, whose



whose cases, independent on their perverseness, afforded the most unfavourable prognostics, and obliged me to depend entirely on external applications. The following method of cure I have hitherto successfully pursued.

A PLASTER composed of *Emplast. Stomach.* or *Emplast. à Cymino* p. ij. *Emp. Vesic.* p. j. *Camph. S. V. R. trit.* ʒiss, is directed to be applied to the nape of the neck, and a cataplasm of *Cort. Peruv.* & *Flor. Chamæm.* boiled in vinegar, with the addition of two drachms of camphor, to be laid across the throat, and renewed every four hours. Sometimes instead of this cataplasm, a flannel moistened with equal parts of camphorated spirit of wine and vinegar is recommended, which is highly refreshing and grateful to the patient.

A PEDILUVIUM consisting of the above-mentioned ingredients, viz. bark and chamomile flowers, boiled in vinegar and  
water

water, is prescribed to be used three or four times in a day. When the weakness of the patient renders him unable to sit with his feet in the bath, cloths lightly wrung out of the decoction are ordered to be wrapped round his legs and thighs.

To medicate the air, both for the benefit of the patient and of his attendants, such a composition as Dr. Huxham recommends, viz. chamomile flowers, rosemary and myrrh with vinegar, is advised to be kept boiling over the lamp of a tea-kettle, so that the vapour, which is by no means disagreeable, may be diffused through the room; and the lamp is sometimes placed near the bedside of the sick person, that he may inspire the antiseptic steams more copiously.

My reason for prescribing a blistering plaster under the form above directed, is because I have found by experience, that the skin in this disorder is very easily inflamed and vesicated; and that a sufficiently

ently copious discharge of serum is procured by this composition, which at the same time coincides with the general indication of correcting putridity. And I must here beg leave to remark, that early blistering in the *angina maligna* has a peculiarly good effect; though I am no advocate in general for the application of vesicatories, in the beginning of fevers.

THE cataplasm seems to me, to answer several useful purposes: It tends to soften and relax the glands of the neck, which are often tumefied in this disorder; it continually exhales an antiseptic vapour, which is drawn into the mouth and fauces at every inspiration; and no inconsiderable portion of it is carried into the system by absorption. And it appears not improbable, from the common methods of preventing putrefaction in animal flesh, that some part of it may pass to the seat of the disease, by penetrating through the interstices of the muscular fibres,

fibres, when the cellular membrane is not loaded with fat.

THE use of the *pediluvium* in every species of fever is acknowledged to be highly serviceable, and is peculiarly so in this disorder, in which the skin is hot and dry, and the efflorescence on the surface of the body apt to disappear from the slightest causes, producing an aggravation of all the symptoms. Besides its relaxing and antispasmodic effects, it tends to bring on a swelling of the feet, which I have sometimes observed, to be so beneficial to the patient, as almost inclined me to think it a critical derivation. By the addition of bark, chamomile flowers, and vinegar, the *pediluvium* is rendered powerfully antiseptic, without any diminution of its other effects. An ingenious writer has proposed a method of conveying a very large portion of nitre into the body, as a corrector of putrefaction; but in the sore throat, and every putrid disease, could such a quantity be  
intro-



introduced into the course of the circulation, it would, I apprehend, disappoint our expectations, and by weakening the *vis vitæ* increase the septic ferment.

THESE means assiduously pursued, have hitherto succeeded to my wishes, though I should not chuse to trust to them alone when other remedies could be employed. However such is my confidence in their efficacy, that I would never fail to recommend them, along with frequent gargling, and the internal use of the *cortex*, wine, &c.

AN eminent practitioner has very judiciously recommended, in the first stage of the disorder, the washing of the stomach with a gentle emetic. This advice I have generally pursued, and have always observed, that it mitigated the violence of the symptoms, and in some instances has entirely removed the disease. The efficacy of emetics in this distemper is not to be ascribed solely to the evacuation



cuation which they produce of the contents of the stomach, but to their unloading the glands of the throat, promoting an equal circulation, and increasing perspiration.

I do not recollect that any authors have taken notice of a symptom, which has not unfrequently attended the sore throat, as it has appeared in this neighbourhood, I mean a very fœtid, ichorous discharge from the ears. In the beginning of the present summer (1770) this symptom occurred only in the worst cases, and such as generally proved fatal: I have lately observed it several times when the patient has recovered; but indurated parotids, and deafness have ensued.

I HAVE met with several cases in which all the symptoms of the *angina maligna* have appeared, excepting the ulcers of the throat: Nor could there be any doubt concerning the nature of the disease, as the patients had been exposed to the  
infection

infection of it. These instances, I apprehend, incontestibly prove the ulcerous sore throat to be a distemper of the whole habit, and not almost entirely a local affection, as may be inferred to be the opinion of a very learned and eminent Physician, whose writings contain a treasure of medical knowledge, from his laying *the chief stress of the cure on gargling.*

ALTHOUGH we should be cautious in the use of the vegetable acids, from their tendency to renew or increase the *diarrhœa*, yet the mineral acids are not liable to this objection, and I think may be administered with great advantage. I frequently direct the dulcified spirit of nitre to be given freely in an infusion of red rose leaves, mixed with port wine. It is cordial, antiseptic, and gently diaphoretic, and thus answers several very important indications.

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# T H E E N D.

## E R R A T A.

- Page 11, line 11, for Potterfield read Porterfield.
- Page 30, line 9, for epedemic read epidemic.
- Page 98, line 18, for floclulent read flocculent.
- Page 124, line 12, after solution read of.
- Page 135, line 3 of the note, for proabbly read probably.
- Page 143, line 8, for ceger read æger.
- Page 147, line 7, for ilico read illico.
- Page 226, line 5, for begun read began.
- Page 241, line 11, for alternative read alternate.
- Page 252, line 20, for broke read broken.
- Page 260, line 2 of the note, for sacharine read saccharine.
- Page 260, line 9, for realy read really.
- Page 294, twice, for facharum read saccharum.
- Page 306, line 7, for Swieten read Swieten.
- Page 307, line 15, for therefote read therefore.
- Page 308, line 22, for facharum read saccharum.
- Page 317, line ult. for rhuburb read rhubarb.
- Page 337, line 23, dele other.
- Page 350, Motto, for phoenomena read phænomena.
- Page 378, line 1, for on read independent of.









